ELECTRICAL WORLD
AND
Electrical Engineer.

ELECTRICAL WORLD, Vol. 33, No. 15. NEW YORK, APRIL 15, 1899. ELECTRICAL ENGINEER, Vol. 27, No. 571.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(Incorporated).

9 MURRAY STREET, NEW YORK.

Telephone Call: 924 Cortlandt. Cable Address: Electrical, New York.

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TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - per year, $3.00
Foreign Countries within the Postal Union, - - - - - 6.00
Single Copies, - - - - - - - - - - - .10

In requesting your address changed, give OLD as well as new address.

(Entered as second-class mail matter at the New York Post Office.)

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NEW YORK, SATURDAY, APRIL 15, 1899.

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The Nature of Lightning Discharges.

In another column Dr. W. J. Morton puts forth an hypothesis on the nature of lightning discharges which, we fear, rests on a rather slender basis. Having noticed that photographs of lightning and other disruptive discharges present a spiraling appearance, he advances the opinion that the discharges themselves are spiraling; and furthermore, that the irregular path of disruption discharges is due to the existence of nodes. The conclusion arrived at has not been submitted to the test offered by the mathematical theory of oscillatory discharges, and would appear to be otherwise unsafe from the showing of a photographic plate alone in the absence of experiments as to the influence of the photographic lens and negative in introducing distortions in the light received. The question opened up is, however, an interesting one and might well be examined mathematically to determine if it receives any support from accepted theories based upon the assumed nature of the stress phenomena accompanying disruptive discharges.

Commemorating Volta.

Next month the discovery of the electric pile or battery is to be celebrated with due festivities and solemnities at Como, Italy. There is to be an electrical exhibition opening May 15 and a bronze wreath is to be attached to the Volta bust. The telegraphers of this country have subscribed to the wreath liberally and are sending one of their number as a delegate to the telegraphic congress to be held at the same time. This is excellent, but it falls short of doing justice to the occasion. We venture to suggest that as an electrical exhibition will be in full swing in this city, there should be an effort made to get in closer touch with our Italian friends on that occasion. Why not have a Volta night on May 14? Why should not the exhibition management, the National Electric Light Association, under whose auspices the exhibition is given; the American Institute of Electrical Engineers, the New York Electrical Society, and other electrical bodies get together at Madison Square Garden, and send messages of goodwill and fellowship to the Volta exhibition in Italy? It can be made an occasion of great scientific and popular interest, and we venture to suggest that in the formative hands of Mr. Francis W. Jones and Mr. John W. Lieb, Jr. (formerly of Milan), Lieut. Bettini and others, the affair can be made to redound to the credit of all concerned, as well as to the honor of the great and immortal Italian.

Return Feeders For Electric Railway Systems.

It is astounding and almost criminal that the electric railway systems of this country should go on dissolving the water and gas pipes in the districts through which they run, as well as the lead sheathing of their own and others' underground cables, when such simple means are at hand for greatly reducing this wholesale destruction of property. Probably few street railway managers realize the extent by which a properly laid out system would reduce this evil, or if they do realize it, fear the added investment in copper which it would necessitate, although the reduced liability for electrolytic losses should certainly warrant a considerable increase of the fixed charges.

The whole solution of the problem and practically the only solution so long as a ground return is used is to put in insulated return feeders, not in the perfunctory way that such feeders are generally used in this country, but as a completely worked out system. The rails with their high conductivity and low cost as a conductor must be abandoned for the purpose of returning current to the power house if electrolysis is to be prevented, and used solely as the mains of a feeder and main network, exactly analogous with that of low-potential lighting systems. Customary practice at present is to directly connect the negative bus of the generating station to the rails at their nearest point, giving the track at this point the minimum potential of the whole system and utilizing so far as possible the metal of the rails for taking current back from the more distant portions of the line. Only when the cross sections of the rails is insufficient to bring the current in without excessive drop—and outrageously high drops are allowed in railway service—are return feeders added, and never is a constant feeder and main system designed to maintain constant potential at the rails carried out. The line is generally figured for a 5 per cent. or 25-volt drop between the distant ends and the section adjacent to the power house, but the deterioration of bonds and the growth of traffic beyond that anticipated often doubles this drop, so that there may be a potential difference of 50 volts between sections of the grounded return system—enough with the great current flowing to force its way through a wide sweep of area about the lines and eat whatever metal it can find buried in the soil. Better bonds, heavier rails and more return copper can be added, but so long as the rails are used as a return the reduction of the drop below 10 or 15 volts would require an excessive cost of the conducting system.

The only way to really reduce the potential difference between all parts of the rails below a safe limit is to abolish the direct connection between the rails and the negative bus, and tap the rails at various points by insulated return feeders (not bare copper cable) so proportioned that under average conditions the drop in all of them will be the same. If the load is uniformly distributed over the line and the return feeders are uniformly spaced they should all have the same resistance, and if the longest ones have a drop of 25 volts at full load, the connection between the negative bus and the rails in front of the station should also have an artificial resistance which will give a drop of 25 volts. In this way the potential of the rails will be considerably higher than that of the negative bus but will be quite uniform throughout the system, varying of course slightly from time to time as the load and its distribution fluctuates. In this way the maximum potential difference between various points on the rails may easily be kept within 5 volts, and during the greater part of the time less than this. The current tending to pass through the ground will not always be in the same direction, but will at times tend from one district to another, and at other times from the other district to the one, so that the electrolytic effect will be much less than with a unidirectional current of the same ampere hours.

To illustrate how greatly the potential difference can be reduced figures are given below based on the assumed case of a line ten miles in length with a track resistance from end to end of 0.2 of one ohm with the power house at one end, and 35 cars running, each taking an average load of 15 amperes. If the rails alone are depended upon for the return circuit, being connected at the power house directly with the bus bar, the drop within them will be approximately 50 volts. If, on the other hand, an insulated return feeder is run out to the other end of the line and the direct connection to the rails is broken and replaced by a resistance equal to that of the return feeder, the maximum potential difference between any two points upon the rails falls to 12 volts. If another return feeder of the same cross section as that already in service is connected between the power house and the middle of the line, the potential difference on the rails falls to 3 volts, and if two intermediate cables are connected to points respectively between the middle and the two ends, the rail drop falls to 1.3 volts. The difference between 1.3 and 50 is considerable when electrolysis is in question, and it should be noticed that this result is obtainable no matter what the amount of copper used in the return feeders is. The drop in the five return feeders assumed in the last case may be 100 volts, but the electromotive force which tends to cause electrolysis is reduced to 1.3 volts.

FLY-WHEEL ACTION.

When a stubborn mule refuses to go in the direction in which he is led, one way to make him do so is to use a force greater than the one which the mule can exert in the opposite direction. Such methods are not infrequently used in engineering and often with success, but like in the above case they are sometimes not the best and may occasionally fail. When a rotary motion is not as steady as is desired, a flywheel is generally added, and if irregularities still exist, the flywheel is made heavier. This has led to the idea that freedom from fluctuations is only a question of weight of flywheel. Sometimes, however, this simple application of brute force is not only not the best method, but may even make matters worse.

A recent case of this kind was shown in an interesting discussion by the well-known electrical engineer, Mr. Gisbert Kapp, referring to the case of large direct-driven steam generators connected in parallel. If they develop that very objectionable pendulum-like oscillation, it is natural to suppose that by increasing the flywheel action, they would run better. He shows, however, that this is not the case, as an increase of the flywheel may even favor the oscillations or surgings. He shows that it is really a question of mechanical resonance or synchronism between two tendencies to oscillate, and that if these two periodic forces are carefully calculated and then proportioned so that they are incommensurate with each other, they cannot synchronize. It is therefore a question of calculation and not of brute force, and an increase of flywheel action may even tend to increase the tendency to synchronize instead of the reverse. It may be much cheaper, quicker and simpler to add a little more iron to a flywheel, as a cheap mechanic can do that, but it is not as sure and reliable as it is to have the matter carefully investigated by one capable of doing so.

FIGURING THE COST OF LIGHTS.

A pretty little dispute has arisen in Detroit over the cost of the arc lights furnished by the municipal plant. It is a matter of notoriety in electrical circles that Detroit, owing to the alleged superior economies of a city plant over a private plant, claimed to be getting an arc light at an average annual cost of not to exceed $83.50. This price, or something near it, has, indeed, been paraded all over the country as one of the banner arguments for municipalization. But now comes Commissioner Ingram, who, while not insisting with positive assertion on an exact figure, states that the cost must be somewhere around $109.50. According to his statement, depreciation has not been charged as part of the operating cost, nor has it been deducted from the investment account. Supposedly the city has $800,000 now in its plant, but Mr. Ingram contends that it cannot possibly represent that value intrinsically, simply because that has been the cost to date. The way the price of $83 is got at is by allowing $51 for cost of operating and 8 per cent. for fixed charges on $800,000. But if, as Mr. Ingram hints, there is al-

ready an official proposition to write off $200,000 to profit and loss, we can "see the finish" of the plant in considerably less time than the calculated rate of depreciation would imply.

Mr. Ingram states that the fixed charges are interest on the supposed investment at 4 per cent.; depreciation at 3 per cent., lost taxes, 1 per cent., or 8 per cent. in all. We can only commend these items for their idyllic simplicity. Many of our readers are doubtless aware that on the heavy class of New England mill machinery, which is rated at a lower scale of depreciation than any other, the items run thus: Interest, 5 per cent.; depreciation, 3½; repairs, 2; taxes and insurance, 1; making 11½ per cent. We are now asked to concede that on electric lighting apparatus the rate is about half of the above for depreciation and repairs! It is to be wished it were so, but anybody who can show such apparatus, however well built, that has been good for between 20 and 30 years, will confer an inestimable favor on the community by now coming forward. Our fear is that the municipal luminaries of Detroit will find themselves operating the city plant as a cost of $120 per light per year.

High-Economy Incandescent Lamps.

It seems to be a difficult matter to bring lamp users to a realization of the fact that the solution of the problem of the use of high-economy lamps is one which does not lie with the manufacturer, but with the user. In other words, the problem resolves itself into one of operating lamps always at their rated voltage. This implies for a complete solution a constant voltage—that is to say, perfect regulation—and the use on the same circuit of lamps of different voltages, the latter consideration being due to the fact that owing to drop, a lamp at one point of the circuit is subjected to a higher voltage than a lamp at another point. In some of the larger city plants both of these principles are recognized, the voltage not only being very closely regulated, but lamps of different voltages being used on different parts of the circuit.

The reluctance of lamp manufacturers to sell high-economy lamps where they know the conditions of operation are not favorable, has been often misunderstood. Several years ago, for example, a well-known central station man asserted at an electric light convention that lamp manufacturers were disinclined to furnish low-economy lamps from ulterior motives—insinuating, in fact, a conspiracy on their part against central station interests. Though some of the essential processes of incandescent lamp manufacture are not divulged, we believe we are not mistaken in saying that the high-economy lamp is in manufacture essentially the same as the low-economy lamp, the superior economy with the former being due to the higher incandescence at which the filament is used. Unfortunately, at the upper limit, there is little margin between an incandescence at which the filament will have its normal life and a higher one at which the life will be much shorter. Consequently, in order to protect themselves, manufacturers in recommending lamps necessarily keep in view the extreme voltage, with the consequence that while the lamps recommended may be actually high-economy lamps at this voltage, they are low-economy lamps on the basis of the rated station voltage.

Resonance in Alternating-Current Circuits.

In the last five years great advances have been made in alternating-current transmission, and during this time no little store of experience with their use has been acquired. When alternating-current circuits were first tried, their remarkable properties produced no little astonishment. Take for example the Deptford transmission, which employed a comparatively long subterranean cable. When it was announced that a rise of pressure occurred in this cable, towards the distant end, the statement was generally discredited. It is now known, however, that at no load, under similar conditions, some rise of pressure towards the distant end must be looked for. This effect was attributed to electric resonance.

In simple alternating-current circuits comprising a condenser in series with an inductance and a generator, the resonance which may occur can do so at one particular frequency only, assuming fixed values for the frequencies, inductance and capacity. Moreover, resonance occurs in such a circuit when the reactance vanishes by reason of the inductance-reactance neutralizing or cancelling the capacity reactance. When the frequency of the current is such as to bring about this relation the current strength in the circuit may be theoretically, indefinitely great, and practically, many times as great as the current strength at other frequencies. The resonant rise of pressure at the condenser terminals follows the resonant rise of current. The characteristic property of resonance in a simple circuit of this character is that only one frequency exists at which complete resonance develops.

In the case of an alternating-current transmission line, however, the inductance and capacity are distributed throughout its length and are not localized as in a single induction coil or condenser. Moreover, the capacity is arranged in shunt instead of in series with the inductance. Owing to these changes of condition, there is, under favorable circumstances, a rise of pressure towards the end remote from the generator; but this resonant effect is not limited to any one particular frequency, but occurs in varying degrees with an infinite number of frequencies or with all frequencies above a certain limit. Consequently, the characteristic property of a single-valued frequency does not attach to line resonance, and the phenomena can only be regarded as due to resonance by an extension of the meaning of that term. In reality, the effects are the natural consequences of distributed resistance inductance and capacity, with forced oscillations.

Yet another set of conditions is determined when an insulated transmission circuit receives a high pressure impulse, in place of the alternating pressure maintained by a generator. This corresponds to the case of an induced charge caused by a lightning flash. Here the charge propagates itself along the circuit in the form of wave trains of definitely associated frequencies, and the resonant effect is such as might be produced by a number of separate alternators of definitely co-ordinating frequencies all coacting. This is a case of free oscillations.

A third set of conditions is determined by the combination of the two preceding, and in which free oscillations accompany forced oscillations. This may occur when a switch is opened between an alternating-current generator and a transmission line. The opening of the switch may give rise to a disturbance due to self-induction of the interrupted current, and the free oscillations of this disturbance are superposed upon the decaying forced oscillations due to the generator as communicated through the arc at the switch contacts. It is this combination of free and forced surgings which is the danger that high-pressure cables are exposed to, when their circuit switches are opened, and although the danger has been greatly exaggerated, yet conditions may occur in which it is not to be despised. The case is essentially a complex one, and its severity depends upon the accidental coincidence of the forced and free surges, into a surge which may result in a local pressure high enough to puncture the insulation.

No doubt as experience accumulates and theory develops the safeguard of a cable will be assured against such accidents as the above, but meanwhile the conditions have to be faced as a possible although not a serious menace.

Mr. Croker on Municipal Gas Plants.

Mr. Richard Croker, who, it is asserted, inspired the resolution in favor of a municipal gas plant which was adopted by the general committee of Tammany Hall on Friday evening, last week, thinks that such a plant would be of great value to the city and would return a large profit to the municipal treasury. In speaking of it Mr. Croker said: "I believe that the city makes a profit of $7,000,000 a year out of the water supply system. I don't know of any reason why the city should not make as much out of a gas plant. The city could build the plant for $20,000,000 and could make a profit of $6,000,000 a year selling gas at 70 cents a thousand. The Democratic party will carry this fight to a finish, and it will at least result in showing what the position of the Republicans on the question of cheap gas is. Why, if they must have investigations, do they not investigate their own position in regard to gas?"

The Proposed Independent Telephone Consolidation.

Mr. W. T. Blaine, of the Victor Telephone Company, who is one of the leading engineers of the proposed consolidation of independent telephone manufacturers, was in New York again this week, accompanied by Mr. Douglas Dyrenforth, of the well-known Western patent firm of Dyrenforth & Dyrenforth, who have in charge a number of patent questions connected with the deal. Mr. Blaine's attention was called to the subjoined item, which had been run out on the ticker tape, industriously circulated and printed in some of the financial organs: "Chicago—Word has reached Chicago that the promoters of the American Independent Telephone Company have been interrupted in their plans to launch the big anti-Bell combine. It is stated that inability to secure financial backing necessary to float the $7,000,000 project may compel the abandonment of the American company."

With regard to this Mr. Blaine smiled and said: "The results will show. There is nothing new to add to the situation. You cannot change an accomplished fact by any amount of talking, and we prefer to say nothing until the proper time arrives for the full disclosure of our plans, our officers, and the other bases of our business. The matter is one of altogether too much importance to be dealt with hurriedly, and like sensible business men, we have little or nothing to say publicly of our own affairs. The programme that I gave in the ELECTRICAL WORLD AND ENGINEER last week is being carried out."

In connection with the use of the name of the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, as associated with the consolidation, we have received from that concern, under date of April 8, the following letter, accompanied by considerable printing matter on the subject:

We herewith inclose clipping of Chicago *Record*, giving an account of a proposed amalgamation of all independent telephone manufacturing interests.

You will note that the promoters have evidently reported us as in the combine, but the *Record's* representative's interview you will find quite to the contrary.

While the combine has made us very flattering offers and stated that if we remained outside of the trust they would force us out of business, we are, however, taking the stand of an anti-monopoly and a strictly independent telephone manufacturing company.

We believe that the future of independent telephony to a large extent, depends on the manufacturers, but the standardizing of apparatus and systems should be left to the good judgment of the exchange builders and not in the hands of one manufacturing combination.

With the above in view, and having a complete line of public exchange apparatus of the regular type, as well as the only independent central energy system that has been demonstrated in actual exchange operation for a sufficient period to warrant its general adoption, and a strictly multiple switchboard which can be built for any sized telephone exchange, also one of the most convenient and durable private plant intercommunicating systems now in use, as well as a complete police signal and telephone system, and being in a position to make any special apparatus required in the telephone line, we see no reason for combining with other manufacturers and propose to remain strictly *independent*, notwithstanding the offers and threats the present proposed combination are making.

Proposed Municipal Trolleys at Detroit.

Following of the proposed enforcement of the McLeod law enabling the city of Detroit to purchase and operate street railways, Mayor Maybury has now interposed a veto on some of the plans of the city council in that direction, and matters are not moving forward very briskly. On April 8, Prosecuting Attorney Allan H. Frazer, of Wayne county, by his refusal to lend his official name to the quo warranto proceedings demanded by the dozen or so opponents to the municipal ownership of street railways, gave that opposition the hardest blow it has yet had. The next step the opposition must make is to apply to Attorney General Oren for his official sanction, but that is as good as refused already, as he has publicly expressed his belief that the opposition has no legal grounds upon which to base its demand for a quo warranto proceeding.

There is a single avenue of relief left to the opponents of the measure and that is to apply to the Supreme Court for a mandamus to compel Prosecuting Attorney Frazer to start proceedings. There is said to be no doubt that public sentiment is in favor of Pingree's commission and not with the opposition.

Drought and the Municipal Power Plant at Austin, Tex.

The protracted drought in West Texas is having a serious effect on the city of Austin, Texas. A few years ago that city constructed a large artificial lake by building a mammoth dam across the Colorado river. The cost of this dam was $1,000,000. An electric and waterworks plant was constructed at a cost of $600,000 and the waters of the lake afforded the power for the machinery of the plant. The dam is a great piece of masonry work. It is sixty feet from its crest to the bottom of the lake. Owing to the lack of rain along the upper course of the Colorado river the water in the lake began to recede a few months ago and this absorption has continued until the surface of the water is now nine feet below the crest of the dam. As the water receded the lack of power for operating the electric plant became apparent and the lights ceased to be furnished residences over a month ago. About two weeks ago the plant ceased operation almost entirely, the only power furnished being to newspaper and printing establishments.

Two street railway companies, the Austin Dam & Suburban and the Austin Rapid Transit companies, have contracts with the city for power from the city plant, and when the latter shut down the Austin Rapid Transit Company went back to the old mule power system, while the Austin Dam & Suburban Company are hauling their cars with locomotives rented for the purpose from the Houston & Texas Central Railway Company. The superintendents of these two street railway companies have given no intimation yet that they intend to hold the city for damages for the enforced violation of contracts. The city has been in complete darkness for the past two weeks. The private lighting company there has had a considerable number of customers in the residence districts.

Superintendent Patterson, of the plant, states that just as soon as abundant rains have filled the lake the operation of the electric plant will be resumed. In order that the city may be prepared for such an emergency as now exists, in the future, it is proposed to put in an auxiliary steam plant. Superintendent Patterson is now drawing the plans for this improvement. It is estimated that the cost of the engine, etc., necessary will be about $50,000. The necessity for this auxiliary plant is so apparent that it is believed the improvement will be ordered by the city council without opposition when the proposition is laid before that body.

It is charged that there are serious engineering defects in the construction of the great dam and these alleged defects will be remedied as rapidly as possible. The promoters of the gigantic project led the people of Austin to believe that the creation of this great water power reservoir would induce the establishment of many large manufacturing concerns and that the city would derive a big profit on the large amount of money expended in the construction of the dam. This hopeful view of the future has not yet been realized and it will be many years before the revenue from that source is of any consequence.

The recent decline in the waters of the lake is also attributable partly to a leak which is known to exist at some point in the dam. The discovery that there is a considerable volume of water constantly escaping through this leak was made some time ago and an earnest effort has been made to discover its whereabouts, but up to this time this search has been unsuccessful.

Switchboard of the Chelsea Power Station, Lynn & Boston Railway.

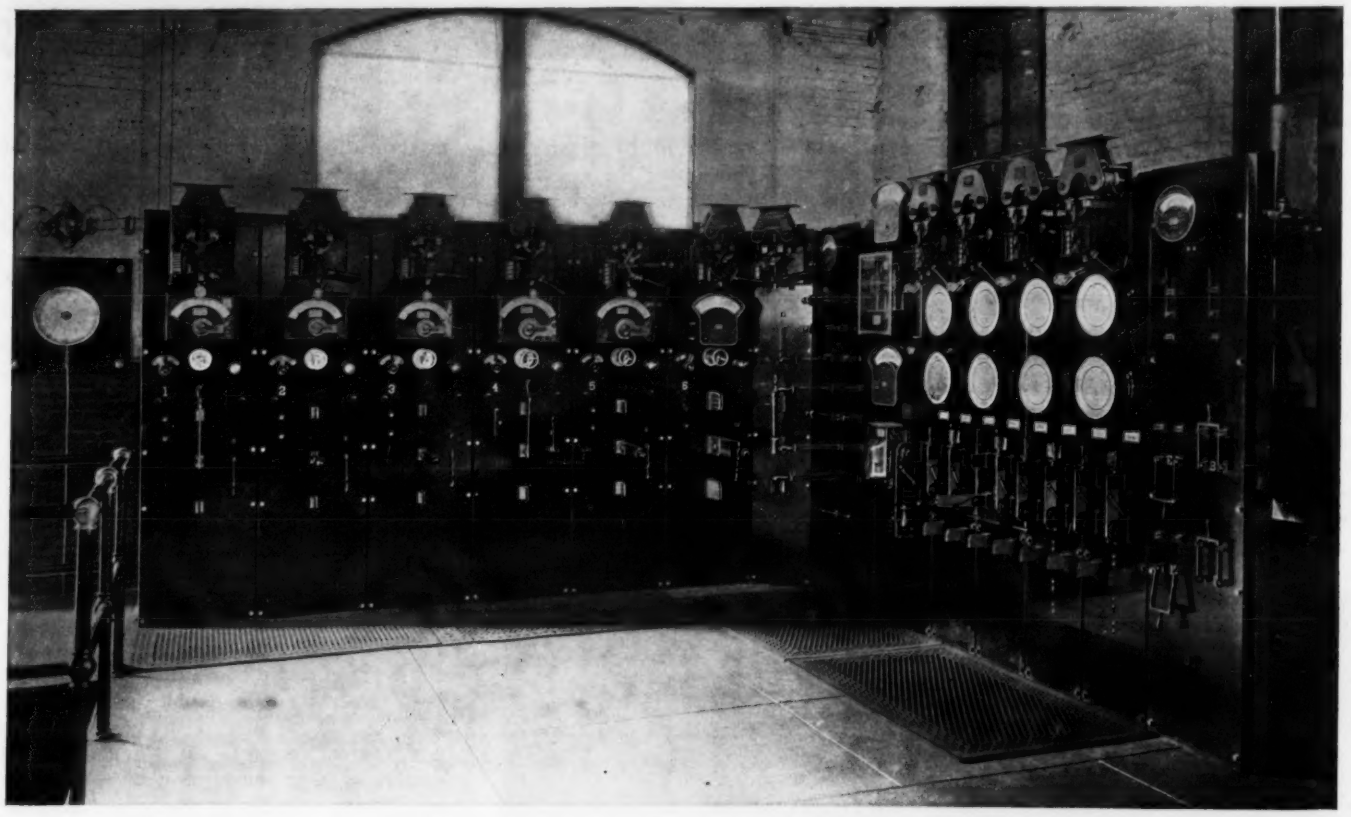
By H. Wray Weller, C. E.

As is well known, the usual type of switchboard installed in railway power stations is liable to trouble at any time from short circuits, many of which are started by the high potential induced by the sudden opening of the circuit breakers, besides the danger due from the proximity of the positive and negative connections on the standard generator panels.

In order to eliminate, as far as possible, these troubles, Mr. Maurice Hoopes, consulting engineer of the Lynn & Boston Railway, designed and installed the switchboard illustrated in the accompanying engraving, and during the seven months it has been in daily operation it has proved entirely satisfactory.

To prevent the possibility of trouble from the above causes, nothing but apparatus at a negative potential is installed on the generator panels, while all the positive switches are grouped on a panel by themselves about the middle of the switchboard.

The board is constructed in two wings at right angles to each other, in order to make it more compact and easy of access. One wing contains the six generator panels, and the other the positive panel, station panel, four feeder panels and the lighting panel, while a spare circuit breaker is mounted on a spare panel, located between the two wings at their junction. All the panels are of polished black marbelized slate mounted on rigid iron supports, and presenting a very handsome appearance.



Switchboard in the Chelsea Power Station.

As the station contains three belt-driven General Electric M. P. 350 generators, two similar M. P. 500s, and one direct-connected 850-kw General Electric multipolar, the generator panels correspond to these units.

There are six of these panels, each equipped with a General Electric magnetic circuit breaker, main single-pole double-throw switch, Weston direct-reading ammeter, field switch, rheostat and hand wheel controller, voltmeter switch and pilot lamp, the panel for the large machine having a circuit breaker of 2000 ampere capacity, and an ammeter reading to 2500 amperes. The main switches are double-throw, the upper throw connecting the machine in the usual way, to the negative bus bar, and the lower throw connecting it to a special bus bar, which in turn connects with the spare circuit breaker (2000 ampere capacity) mounted at the top of the spare panel at the junction of the two wings of the board. This circuit breaker connects to the centre of the double-throw switch under it on the same panel, thus enabling this circuit breaker to be thrown on to either the negative or positive bus bar.

If the circuit breaker on any generator panel fails, the spare circuit breaker can be instantly connected to the negative bus and the generator thrown back into service through the spare breaker.

If it should be desired to operate any generator as a "booster," it can be done by means of this spare breaker and switch by connecting the negative, to be used, to the positive bus bar.

On the positive panel are mounted the positive generator switches, and a dynamo galvanometer and galvanometer switch. These generator switches are also double-throw, connecting the machines to either the main or auxiliary bus bar. The bus bars are placed vertically at the back of the panel, and the switches, as shown in the photographic reproduction, work horizontally.

Next to the positive is the station panel. This is equipped with a large Weston station voltmeter with illuminated dial, a Weston station ammeter of 4000 amperes capacity, with illuminated dial, and also two Thomson recording wattmeters, the larger one, with square glass case, being on the main bus bar, and the smaller one on the auxiliary or special busbar.

There are four feeder panels, with two feeders on each—these being on the negative side of the line. Each panel contains one G. E. circuit breaker, two round pattern G. E. ammeters, one for each feeder; two single-pole double-throw switches to connect each feeder with either the main or auxiliary bus bar, and lamps to illuminate the ammeter.

The end panel is for the lighting circuits, and contains one Weston circular pattern ammeter, four double-pole single-throw switches for the four lighting circuits controlling the lights in the engine room, boiler room, basement, and the newel posts in the engine room. There are also two single-pole double-throw switches, which enable the lights to be thrown on the machines or on the line.

In the office is installed a Bristol recording voltmeter, besides which there are Bristol recording steam and vacuum gauges mounted on a separate black polished slate board on the wall of the engine room. On a similar board there is also a large vacuum gauge in plain sight. The six equalizer switches are placed in pairs on boards in the rear of the machines.

It will be thus seen that this board accomplishes the following important connections in addition to the usual one:

It allows any feeder to be supplied by any generator, when it is desired to run some one feeder at a greater drop than the others.

It also enables any generator in the station to be utilized as a "booster" on any feeder. Each of these connections is valuable, especially in a station having heavy loads for a small portion of the year on feeders that run lightly loaded at other times.

There are also some minor changes of detail from the standard board that have been found useful. A dynamo galvanometer is thrown in circuit across the negative switch when the voltmeter plug is inserted. This galvanometer, shown above the positive switches, indicates zero when the generator to which it is connected is at the same potential as the bus. By closing the switch as this needle passes zero, it is much easier to throw in generators, than with the usual two voltmeters, without its disadvantages.

Instead of using the four-point voltmeter plugs, which are apt to cause trouble by not making proper contact, and by their liability to short circuit in the back of the receptacle, a two-point plug was adopted, connecting the negative side of the meter to the generator, while the positive current reaches the voltmeter from the equalizing bus, after the equalizing switch of the generator is closed. As there are two equalizing bus bars, a small single-pole double-throw switch is inserted on the positive side of the voltmeter, connecting it to either bus.

There is also a wattmeter in each positive bus, which may be thrown in series in the main bus for purposes of comparison.

All the electrical instruments are of General Electric or Weston make, and the panels of the switchboard were built, some by the General Electric Company and some by the Albert & J. M. Anderson Manufacturing Company of Boston.

The Spiraling and Vibratory Nature of Lightning and Other Electric Discharges.

By WILLIAM JAMES MORTON, M. D.

I HAVE just read the communication in your issue of Oct. 27, 1898, page 401, entitled "Is This a Curious Lightning Stroke?" at the close of which you say that you would be "glad to have any comments that our readers may care to make on the subject."

Taking advantage of your courteous invitation, I would remark that to my mind Mr. Milne's photograph, reproduced in Fig. 1, exactly represents what I have been led to believe from experimentation, already published in the pages of your journal, to be the true

FIG. 1.

nature of the disruptive discharge whether of lightning or of the lesser discharges of influence and frictional machines. I believe, not that there was motion of the camera, such as has been suggested as an explanation of Mr. Milne's picture, but that the negative presents the exact record of the fact, namely, a phenomenon and not an accident. This phenomenon I think is the rotary nature of the disruptive discharge. By beginning at the right of the illustration and following the principal discharge to just about the centre of the picture it will be seen that the lines of photographed rotation are from right to left, while half-way there is an abrupt change, and the lines are from left to right. The picture looks like a photograph of an "illuminated curl" whose strands presented varying degrees of intensity of light. Only here we have two curls or spirals joined end to end at the middle of the picture and spiraling in opposite directions. Again, an accidental horizontal movement

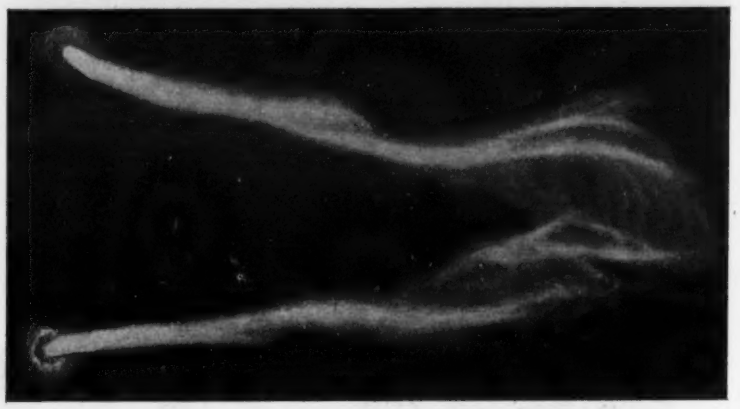


FIG. 2.

of the camera is not, as shown by the print, supposable to account for the direction of the striations, while the movement, if vertical, must have been a double one; namely, for one-half the picture toward the left, and for one-half toward the right, and this simultaneously, a manifest impossibility.

I can probably in no manner make clearer the views I desire to present, in regard to the phenomenon which I think has been recorded in your reproduction of Mr. Milne's photograph, than by quoting some of the conclusions of an article by myself in THE ELECTRICAL ENGINEER of July 20, 1892, above referred to, as follows:

"1. That the electric disruptive discharge or spark consists of two parts traveling in opposite directions, together constituting a current.

"2. That these two parts move in opposite spirals around each other.

"3. That, in the spark form, the direction of the spirals is frequently and mutually alternated.

"4. That the angular, broken, or zigzag appearance of lightning and of large and long sparks represents the point at which the alternations in direction of the double spirals occur.

"5. That if in the air-gap part of an electric circuit a 'current' consists of two parts spiraling around each other the same may be true of the current in the metallic or conducting part of the circuit.

"6. That two spirals moving in opposite directions and upon each other must be subject to friction, and thus occupy time in their progress as well as present other phenomena of friction."

One of the most interesting points in Mr. Milne's photograph to me, is that not only does it present (according to my view) a most beautiful and clearly defined photograph of the spiraling I claimed to have demonstrated by other experiments, but also even presents the very nodal point or point of change in direction which I claimed in conclusions 3 and 4.

Subsequent to my publication appeared an interesting communication from Mr. W. J. Hammer, entitled "Siemens Experiments With High Tension Alternating Currents." He says "the arcs shown in the accompanying illustrations, Figs. 4 and 5, were about 3 feet long, each side being 18 inches long. The cuts shown are made from instantaneous photographs taken by the light of the arcs themselves, and I wish to call especial attention to the striations in the flame and to the spiral character of the arc which should throw some light upon the recent discussions in THE ELEC-

[1]The Electrical Engineer, July 20, 1892, p. 52.
[2]The Electrical Engineer, Nov. 9, 1892, p. 450.
[3]The Electrical Engineer, July 20 and Sept. 14, 1892.

TRICAL ENGINEER. The spiraling is very clearly shown in these beautiful photographs, and it is exceedingly interesting to note, particularly in Fig. 4, that the flame from the right hand electrode is a right hand spiral, while that of the left hand electrode has a left hand spiral." Fig. 4 is here reproduced as Fig. 2.

Yet another hypothesis may be added to the thesis thus far adduced that the nature of the disruptive discharge is spiraling, and this is, that not alone is the discharge spiraling, but also that an entire discharge or any single oscillation constitutes a rate of vibration where each wave is of a spiraling type (probably like reversed corkscrews worked one within the other), and where an electrical node exists indicated by the point where the double spirals take a new or a renewed direction of rotation. From this point of view it is not unlikely that the "zigzag" appearance of lightning and ordinary spark discharges indicates a number of spiraling wave lengths whose nodes are visible as sharp and abrupt changes of direction.

The Use of Electricity as a Motive Power in Modern Steel Works and Blast Furnaces.

By Andrew Ellicott Maccoun.

IN the modern steel works of to-day, electricity as a motive power is gradually taking the place formerly occupied by the smaller class of engines which were used as auxiliaries around the mills. The numerous small engines which were used for operating cranes, rollers, saws, moving tables, charging and drawing machines and tilting ladles, such as at blast furnaces and converting mills, are gradually being replaced by the electric motor, and in some of the more modern mills the only steam machinery in use are the main engines that operate the rolls, which are always of large power with automatic cutoffs and are thus fairly economical. In the changes from engines to motors around mills, there is a great gain in efficiency, as the type of engine formerly used on cranes, rollers, etc., was very uneconomical, not having any cutoff and using over 120 pounds of steam per horse-power-hour.

The motors are as a rule supplied from economical power stations which generate an electrical horse-power under 20 pounds of steam per horse-power-hour, and even if the average efficiency of the ordinary series motor is only from 65 to 75 per cent. and shunt motors from 80 to 90 per cent., it is plainly seen what an enormous saving is effected by their use.

Then there are many other advantages in favor of motors. Long steam lines are done away with, and the losses due to the condensation in these is avoided; the motors do not require the constant attention the engines do—the constant packing of the piston rods, valve stems, etc.—and there is also a great saving in the amount of oil used. In many cases men required to run and attend to an engine were dispensed with, as all the motor needs is to be started and one man can look after a great many.

Around the rolls in mills there are also many other savings effected by the use of motors, as a great many controllers can be bunched together on one platform and one man can operate the same amount of machinery that required three or four with engines. And in nearly all cases where motors are introduced in place of engines, there is some saving of this kind effected together with the gain in efficiency.

Modern motors as a rule give very little trouble, and on intermittent work, such as on cranes, tables, rollers, etc., the standard street car motor is used, usually wound for 250 volts, as this is considered a safe voltage to use around mills, and motors of this type make a very substantial machine, both electrically and mechanically.

In other cases such as for use on saws and shears or in places where constant speed is required, the multipolar shunt or compound motor is used, and as the bearings on these motors are self-oiling, the only attention they need is starting up, and machines of this kind run from one week's end to another. Many electric cranes are also used around steel plants, and nearly all material is lifted and handled by these, as it is by far the most economical method of handling all classes of material. When ingots are delivered from the converting mill to the rolling mill, cranes lift them off the trucks and lower them into soaking pits where they are heated and brought to a uniform temperature; then they lift them out of the pits and deliver them to the rolls. In some places over 1200 tons of hot metal is handled in this way by three men in twelve hours.

After the metal is roughed down by the roughing rolls from an ingot to a bloom, sometimes better results are obtained from reheating before rolling into finished shape, and in that case the bloom is transferred by small electric car which runs into a reheating furnace, being pushed into the furnace by an electric charging buggy and drawn out after being reheated by an electric drawing machine, and then rolled to its finished shape.

Being finished it is usually the most economical method to load the finished product on cars for shipment by electric cranes or other devices, and in some cases when billets are made they run out from the mills after being sheared off to the proper length on conveyors operated by motors, and these drop them into cars for shipment.

In large blast furnace plants motors are now being introduced on hoists; some of these hoists on actual test use only ⅕ the steam that the hoisting engine required—obviously a very large saving. Engines for this use must stop exactly at the same spot, and as it is found impossible to use an engine with an automatic cutoff, they are regulated by throttling the exhaust steam, involving a steam consumption of about 150 lbs. per horse-power-hour. In connection with large furnaces the motors used are about 120 or 150 horse-power and lift seven or eight tons of material 250 feet per minute, and the hoists are entirely automatic after being started.

There are other places around furnaces where motors also play a very important part, such as running mixers and pig machines. The latter machine consists of an endless conveyor with moulds in the shape of an iron pig, and when the iron is not being used directly at the converting mill, it is run on this conveyor and cast into pigs. For scattered work around areas motors give by far the most economical results, and at some furnaces large electric cranes handle all the ore, coke and limestone and deliver it to the furnace hoist, resulting in a great saving in men.

The favor with which electric motors are being received in the class of work described is indicated by the fact that in some steel plants there are from 5000 to 6000 horse-power of motors and the numbers are continually increasing. In addition to the power plant required to operate the motors, there are also, of course, large incandescent and arc light installations.

Improvements in Telephone Systems.—I.

By Kempster B. Miller.

TWO patents issued on February 21 of the present year, and relating to telephone systems of the Hayes common battery type, described in the recent article on "Centralized Sources of Energy in Telephone Exchanges,"* are of much interest. One of these was issued to Mr. G. K. Thompson of Malden, Mass., who has assigned his invention to the American Bell Telephone Company. This patent is peculiarly interesting as being in a class almost by itself. It relates not to telephone systems as they are today, or as they will be in the future, but to the transitory stage in which an exchange usually exists for a considerable period, while the apparatus of yesterday is being replaced by that of to-day.

In reconstructing switchboards it is often desirable to gradually replace the old apparatus by that of more modern design and construction, and it sometimes happens in changing from the old systems, using the local battery and the magneto generator at the subscriber's station, to the new systems wherein all of the sources of energy are centralized, that a large number of lines will be equipped with one class of apparatus and the remainder with the other. The object of this invention is to so arrange the cord circuits and the connected apparatus that the lines equipped according to the old system may be connected with each other or with those equipped according to the new system, or that the lines of either class may be connected indiscriminately with each other without any special attention on the part of the operator.

The details of the invention may be readily comprehended by reference to Fig. 1, in which B^1 and B^2 represent two subscribers stations connected by lines L and L^2 with the central office. L, shown at the left of the figure, is equipped according to the old style of system, wherein the subscriber's station is provided with a call generator, C, and induction coil, I, having a primary, p, and a secondary, s, a local battery, b, together with the transmitter, T, a receiver, t, and a polarized bell, B. This line is connected through the jack, J, with the magnetic drop or annunciator, A. This annun-

*Electrical World, Dec. 24, 1898; Jan. 14 and Feb. 11, 1899.

ciator, is acted upon by the operation of the generator, *C*, at the subscriber's station when the attention of the operator is desired upon that line. The line L^2 shown at the right of the figure, is equipped according to the common battery or relay system described in detail in the article referred to. It is clearly a matter involving much ingenuity to provide a system of cord circuits by which two systems of lines so radically different in all respects can be connected together at random without regard to the classes to which they belong.

In the cord circuit, *P* and P^2, are respectively the answering and the calling plugs. The tip strand, 8, and the sleeve strand, 9, of the plug, *P*, are connected with the terminals of the windings 11 and 22 of the repeating coil, *R*, the other terminals of which connect with the armatures 13 and 37 of the cord relay, *S*. The back contracts of these relay armatures are connected together by wire 17 through one winding of a clearing drop, D. These contacts are also connected by a circuit containing a condenser, *q*, in circuit 18, which is connected in parallel to the circuit 17. The front contacts of the armatures 13 and 37 are connected with the poles of the common battery, *E*, which supplies current for the operation of the various devices, and also for communication. The tip and sleeve strands of the calling plug, P^2, are connected in a precisely similar manner with the windings 12 and 23 of the repeating coil, the other terminals of which are connected with the armatures of a relay, S^2, the back contacts of which are connected together through one winding on the annunciator, *D*, and also through a condenser, q^2, parallel with it. The front contacts of these armatures are connected with the poles of battery *E*, and also with the front contacts of the relay *S*, on the opposite side.

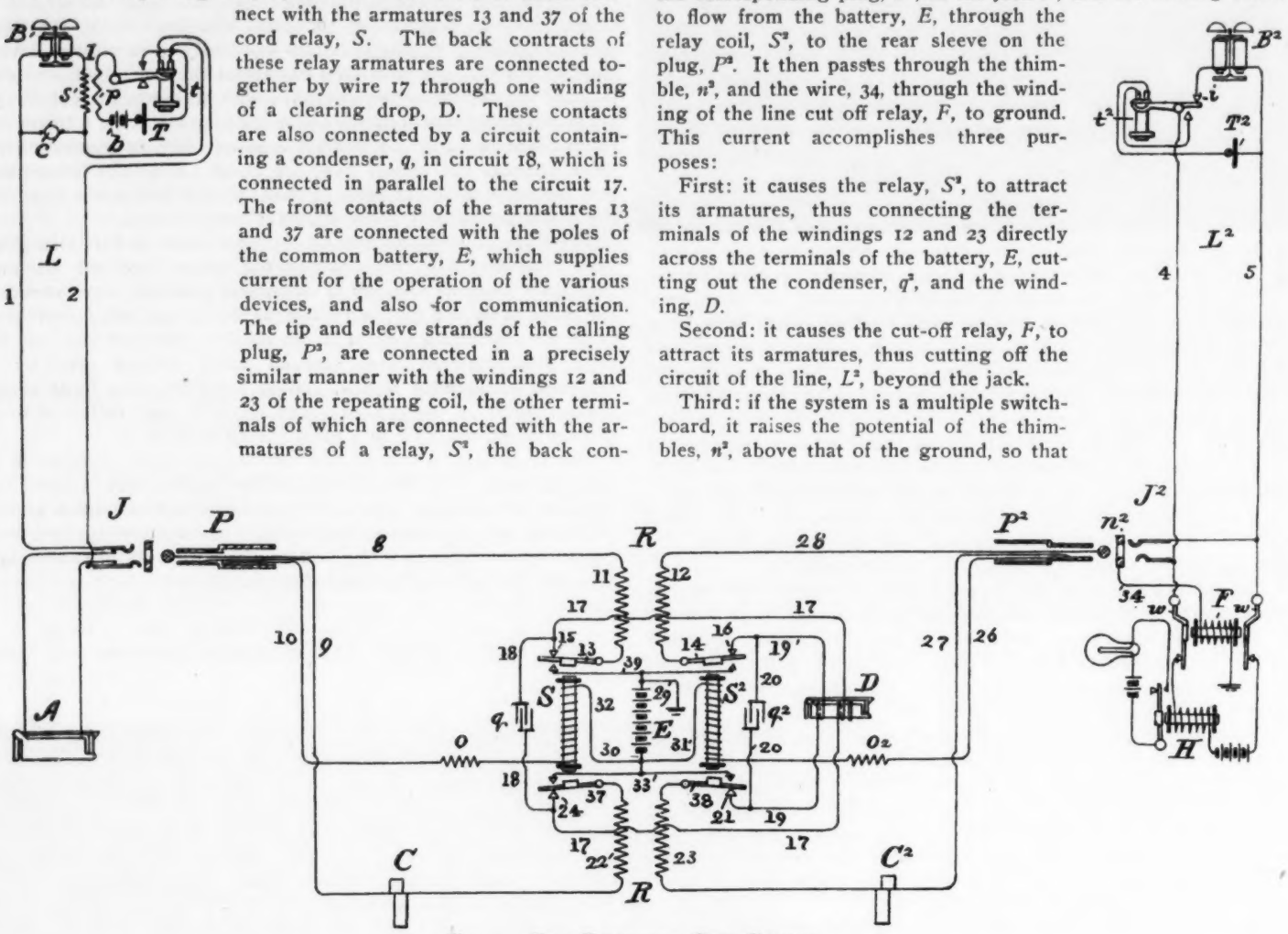


FIG. 1. THE THOMPSON CORD CIRCUIT.

The strand, 10, of the cord, connects the rear sleeve on the plug with one terminal of the winding of the relay, *S*, through a resistance, *o*. The other terminal of this relay winding is connected to one pole of the battery *E*, the other pole of which is grounded. The connection from the rear contact on the plug P^2, is made in an exactly similar manner. The sleeve strand, 9, of the plug, *P*, contains the supervisory signal, *C*, while in the corresponding strand of the plug, P^2, is a similar signal, C^2. Assuming that a subscriber having a line equipped with the old style of apparatus, desires a connection, he operates his gernerator, *C*, the current from which energizes the magnet of the annunciator, *A*, causing it to display its signal. The operator, seeing the signal, inserts plug *P*, into the jack, thus lifting the springs of the jack from their normal anvils and cutting off the circuit through the drop, *A*. At the same time a connection is established between the line wires 1 and 2 and the cord circuit 8 and 9. This produces no effect on the apparatus in the cord circuit, because no circuit is afforded from the ground at 29 through the battery, *E*, and the relay winding, *S*; by virtue of there being no ground on the lines equipped with the old style apparatus. The talking currents from the subscriber, *B*, therefore pass from the tip of the plug, *P*, through the cord strand, 8, winding 11, of the repeating coil, armature, 13, condenser, *q*, armature, 37, and winding 22 of the repeating coil to the sleeve of the plug, and as the tip and sleeve contacts of the plug are connected with the terminals of the line, the circuit from the subscriber's station is completed through this path. These currents flowing in this circuit pass through the condenser, *q*, rather than through the winding of the drop, *D*, on account of their high frequency; they act inductively upon the repeating coil windings 12 and 23, connected with the other plug of the pair. If the connection called for is with a line provided with the new type of apparatus, the operator will insert the corresponding plug, P^2, in the jack J^2, this act causing current to flow from the battery, *E*, through the relay coil, S^2, to the rear sleeve on the plug, P^2. It then passes through the thimble, n^2, and the wire, 34, through the winding of the line cut off relay, *F*, to ground. This current accomplishes three purposes:

First: it causes the relay, S^2, to attract its armatures, thus connecting the terminals of the windings 12 and 23 directly across the terminals of the battery, *E*, cutting out the condenser, q^2, and the winding, *D*.

Second: it causes the cut-off relay, *F*, to attract its armatures, thus cutting off the circuit of the line, L^2, beyond the jack.

Third: if the system is a multiple switchboard, it raises the potential of the thimbles, n^2, above that of the ground, so that an operator testing that line at another board will know that it is busy.

The two subscribers now communicate through the medium of the windings of the repeating coil. Current from the battery, *E*, does not flow to the circuit of line, *L*, that line being provided with a local battery at the substation. On account of the energization of the relay, S^2, the battery, *E*, is connected in circuit with the line, L^2, and therefore furnishes current to the substation of the line, L^2, which is provided with no battery of its own. A little consideration will show that if either of the plugs of a pair is connected with a line equipped with the old-style of apparatus, the battery, *E*, will not be connected with that line, because the relay, *S*, is not energized; while if either plug is connected with a line provided with a new equipment the corresponding relay, *S* or S^2, will be energized, thus connecting the battery, *E*, with that station.

The automatic operation of this system is extended to the clearing out signals. If a sub-station, such as that of line, *L*, rings off, the current from the magneto generator, being of comparatively low frequency will pass in large measure through one of the windings of the clearing out drop, *D*, which will therefore be operated. When, on the other hand, one on the new style stations hangs up his receiver, a high resistance is automatically introduced into that line, which reduces the current flowing from the battery, *E*, to a sufficient extent to de-energize the supervisory signal, *C* or C^2

It would seem that such an elaborate system of cord circuits would be rather an expensive luxury to be enjoyed only while the system is being remodeled. When it is considered, however, that the cord circuits represent but a small portion of the entire apparatus in a large exchange, and that the period of remodeling frequently extends over a long space of time, it becomes apparent that this device may be of great utility, as it will give a practically up-to-date service under very trying circumstances.

Electricity in the Italian Navy—V.

By Giulio Martinez.

THE electric gun and turret training apparatus illustrated and described in the preceding article is controlled by "clothes pin" pressure switches, as illustrated in Fig. 30. This apparatus was worked out and built from M. Pasqalini's designs by the Officina Galileo of Florence, which company has also worked out the same engineer's system for controlling the operations of an electric searchlight from a distance, which system has been adopted in the Italian navy as greatly superior to anything similar used in other countries.

The value of electrically controlled searchlights has been recognized in every naval service. In the Italian navy Commander Rouca long ago suggested it and the first apparatus was got out under his directions. But the ordinary starting switches developed difficulties, making it impossible to exert the control from a sufficiently great distance. M. Pasqualini has reduced the controlling switch to a small box, having four contacts, and which can be carried in the coat pocket, it being connected with the searchlight by a small

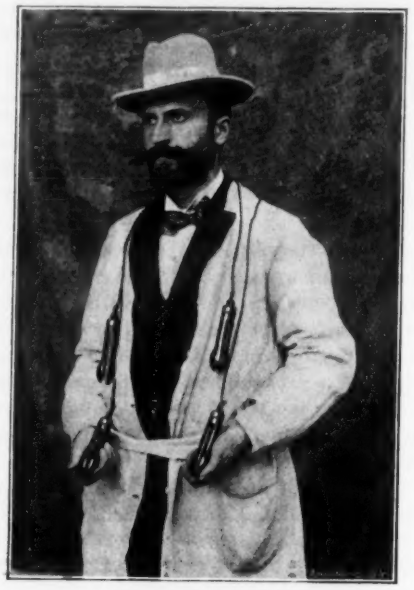


FIG. 30.—METHOD OF USING CLOTHESPIN PRESSURE SWITCHES.

flexible cord. This enables the officer in charge to operate his searchlight, and at the same time to move about; he can control a searchlight on a mast or placed at the water level from any part of the ship.

Although the Officina Galileo is the only company in Italy which turns out a complete searchlight, building every part from the base to the parabolic reflector, it furnishes the navy with the controllable bases only, on which any type of searchlight can be mounted.

This base is shown in Fig. 31 and again with the mechanism jector mounted on the base. Fig. 33 shows the controlling exposed in Fig. 32. Fig. 33 is an outline view of a 24-inch proswitch.

The base is shaped like a drum, about 24 inches in diameter, and nearly as much in height. The lower portion is fixed; the movable part contains a double motor and a double reversing switch. A horizontal shaft projects from one side of the drum, parallel to the horizontal axle, about which the projector rotates; these two axles are connected by a rod of variable length. The current is introduced into the moving part through seven rings and brushes, two of which transmit the current for the arc and for the motors and the other five work the electromagnets of Pasqualini's switch.

The double motor consists of two armatures mounted in a single field magnet carcasse (see Fig. 35), the core of the single coil being the axis about which vertical rotation takes place, and serving also as a very solid connection between the fixed and movable portions. The movable part is made of an alloy of aluminium and rests on steel ball bearings, the fixed part is of bronze.

The armatures run, of course, at rather high speed, necessitating

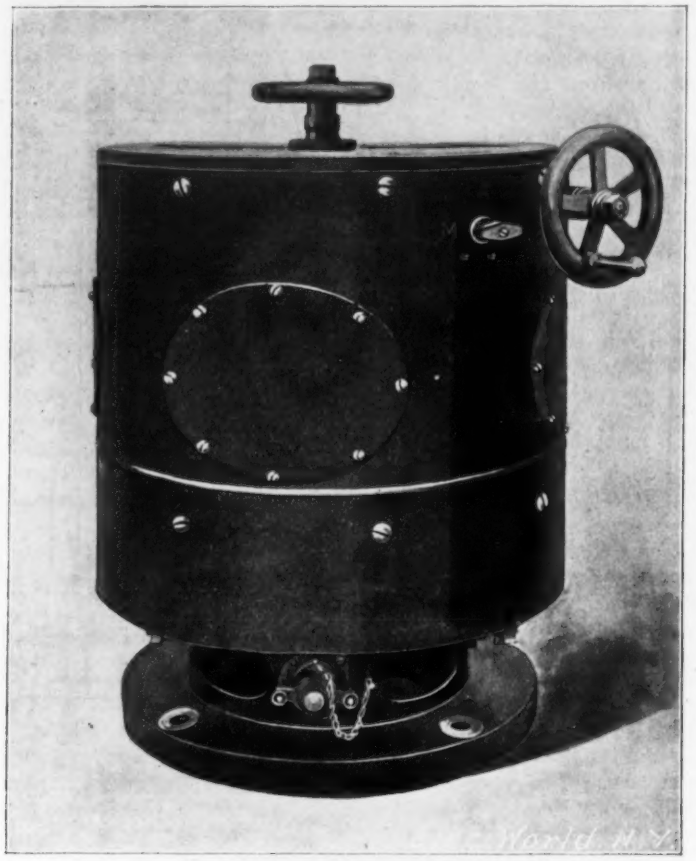


FIG. 31.—SEARCHLIGHT BASE.

speed reduction gears; a reduction in speed of 2500: 1 takes place between the armature controlling the horizontal rotation and the frame; and of 12000: 1 between the armature controlling vertical rotation and the frame. Hand control is provided by a couple of

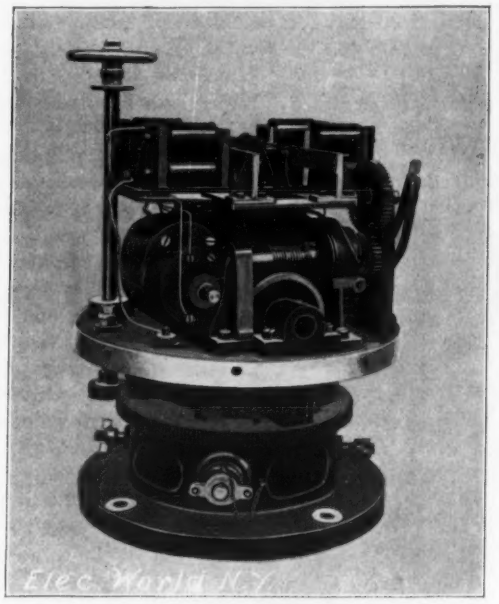


FIG. 32.—INTERIOR OF SEARCHLIGHT BASE.

hand wheels shown in Fig. 31, but when the searchlight is being operated by the electric controller system, a couple of magnetic clutches, one for each plane of rotation, come into play and prevent action through the hand apparatus. These clutches which only

require 7 or 8 watts appear clearly in Fig. 32; when starting they take 30 watts, but as the starting of the motor provides much more than that amount, they need never fail. They are placed in series with the field winding. The motor is series wound, but the two armatures are in parallel with each other.

For the sake of simplifying the connections, a compound winding was not used on the motor, but to secure quick starts and stops it is

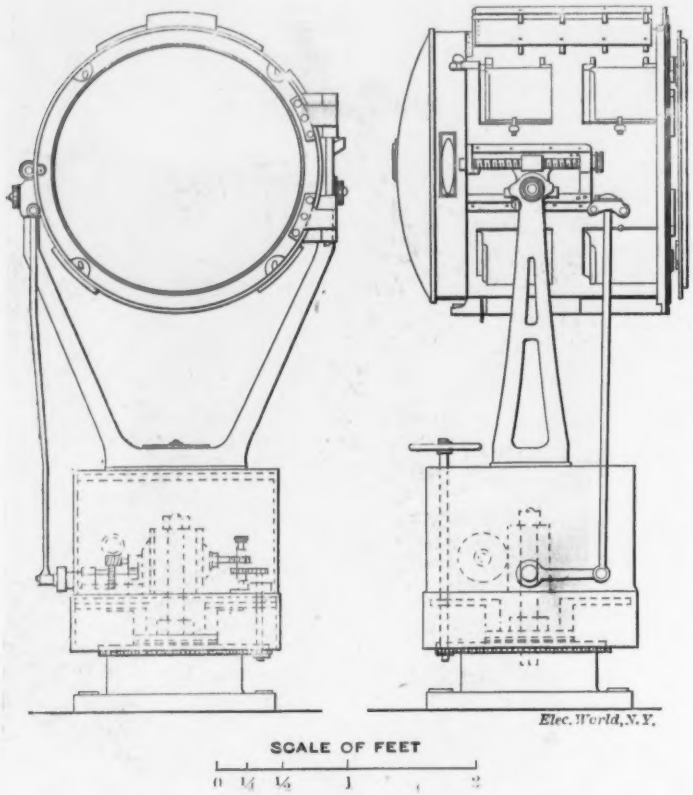


FIG. 33.—OUTLINE VIEW OF 24-INCH PROJECTOR.

necessary to have the field excitation kept up continuously, which is accomplished by putting across the terminus of each armature a resistance of about 60 ohms, which becomes short circuited when the armature circuit is closed. This arrangement which may appear at first sight rather complicated, is in reality the pivotal point of the system, to which it adds several advantages. By way of explanation, let us consider the diagram in Fig. 36 and see how a purely series motor might have been used. Insert two equal resistances, R^1 and R^2 between the blade of each key and the lower metal bar. (See Fig. 36.) When the armature is short circuited, a current flows in the field winding and the two resistances R^1 and R^2 in parallel with each other. On depressing one blade, the armature comes into circuit and short circuits one of the resistances. There is a loss in efficiency, no doubt, owing to some current being shunted past the armature, but the fact of never opening the circuit permits the contacts of the controller to act without dangerous sparking, a vital point. Fig 37 shows the double controller for search-lights.

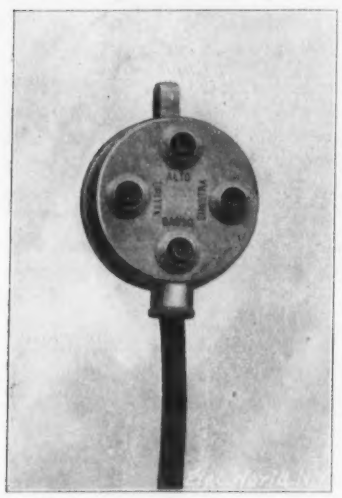


FIG. 34.—SEARCHLIGHT CONTROLLING SWITCH.

By making the pressure on the button very short, it is possible to get a motion as small as $\frac{1}{4000}$ part of the circumference, and even less with a little practice, which enables one to follow a ship with perfect continuity. The maximum speed is 300 degrees per minute, and the operator may be at a great distance from the instrument; experiments over a distance of 4 miles have been quite successful; 16-inch projectors are used now only on torpedo boats, those for larger vessels ranging from 24 to 30 inches.

Mangin's plane mirrors are out of date at present and the parabolic mirror is coming into use. The products of Schuchert, Parson, Clarke and Chapman, and recently of the Officina Galileo, at Florence, have all received a trial. The latter company has put in some very novel machinery for constructing these mirrors. The

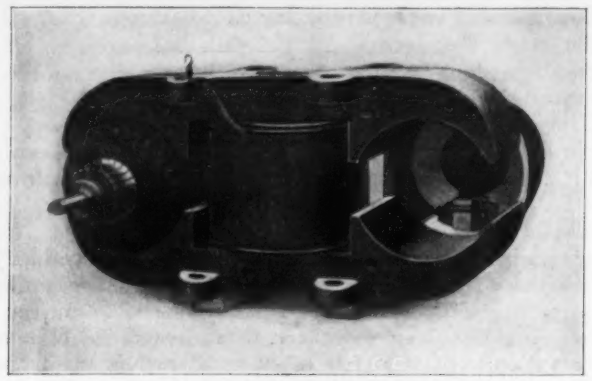


FIG. 35.—SEARCHLIGHT CONTROLLER.

process is entirely cynematic and electricity plays a large part in the construction.

It will be interesting to understand the system of testing which this company has adopted in order to prove the superiority of its

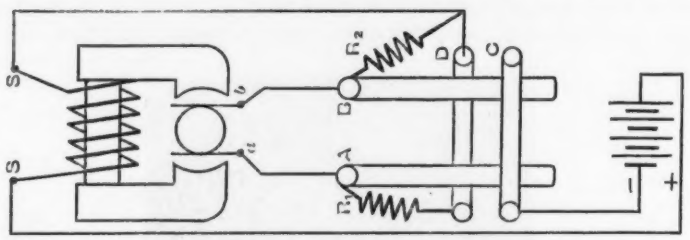


FIG. 36.—DIAGRAM OF CONTROLLER CIRCUIT.

product. The idea is largely due to General Facini, well-known throughout Europe on account of his work in optical telegraphy, and the system was speedily adopted by the navy, because of the certainty with which it discloses any imperfections in a mirror.

Suppose a small diaphragm to be held in the focal plane, and centered on the axis of a parabolic mirror, then since all parallel rays are reflected from the surface of such a mirror through the focus, upon looking through the diaphragm at the image of some object at considerable distance from the mirror, the image will be visible to the observer, no matter where he may place his eye. (Fig. 38.) By determining the smallest diaphragm for which the condi-

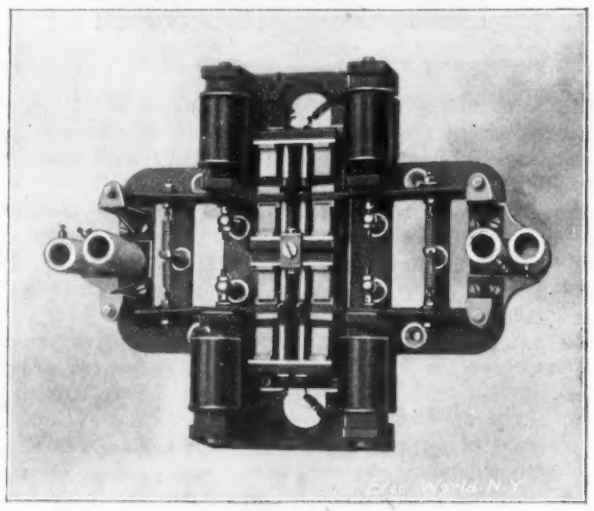


FIG. 37.—SEARCHLIGHT DOUBLE CONTROLLER.

tions are fulfilled, for every point on the surface of the mirror, both the diameter of the circle of aberration and the effective focal distances are determined. Every irregularity in the surface will be

revealed by this examination, which requires nothing more than patience to carry it through.

An indisputable record of the regularity of the surface of a mirror may be obtained by photographing the image of a system of circles intersected by radii.

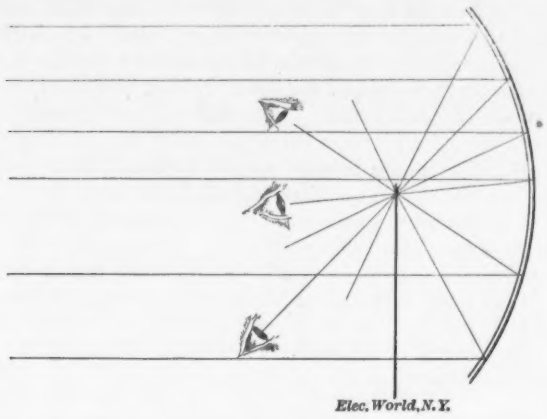


FIG. 38.—METHOD OF TESTING SEARCHLIGHT REFLECTORS.

CURRENT NEWS AND NOTES.

WIRELESS TELEPHONY.—A despatch from Brussels says that some successful experiments have been carried on with the Marconi system in telephoning without wires between that city and Ixelles, a suburb distant some few miles.

BELGIAN TELEPHONE LINES SUFFER FROM A BLIZZARD.—A heavy snowstorm in Brussels and vicinity on March 28 completely disorganized the telephone system. The damage done was so extensive that it will, according to a cablegram, take a month to restore the service.

THE PARIS EDISON COMPANY has recently constructed a tunnel connecting its station at St. Denis, near Paris, with the central station on Avenue Trudaine. This has been done in order to run bare conductors, which will carry a current of 2100 volts, actuating two 1200-kw transformers at the city station, where the generating machinery is now overloaded. The tunnel will be six feet in height, so that a workman wearing an India-rubber suit can pass through the entire length.

DR. J. T. NICHOLSON, professor of mechanical and electrical engineering at McGill University, Montreal, has resigned from that position, and will take charge of the mechanical and electrical engineering departments of the new Municipal Technical School, at Manchester, Eng. The building and equipment of this school, which has just been completed, has cost $750,000, the equipment of the mechanical and electrical department costing $200,000. In his new field, Dr. Nicholson will devote himself very largely to developing new lines of research in practical engineering with special reference to industrial work.

ELECTRIC HEADLIGHTS IN ARIZONA.—The use of electric headlights by some of the engines of the Santa Fe, Prescott & Phœnix Railway in Arizona enables the engineers to see some strange things. Wild animals are said to be hypnotized by the bright lights, and standing transfixed to the track, in some cases until struck by the engines. Engineer Deitweiler is out with a tale of an immense mountain lion that stood looking into the beam until almost struck by the pilot. Engineer Barth's experiences in this line include running down a wildcat, which had been light-hyptonized. He secured the skin, and exhibits it as proof of his story of hunting for wild game with an engine.

LARGE POWER PLANT AT BRITANNIA, ONT.—The Metropolitan Electric Company, of Ottawa, Ont., will, in a few weeks, place an order amounting to $350,000 for the machinery in the power house to be erected at Britannia, eight miles from the city. The power house, when completed, will be unsurpassed by any other in Canada and will be thoroughly equipped with the most improved machinery. The plant will include 20 water wheels of 240-hp each, four large generators, two small generators, switchboards, and other necessary appliances. Work on the power house will be commenced immediately, and the erection of temporary houses is well under way.

A MUNICIPAL ELECTRIC RAILWAY IN CANADA.—The towns of Port Arthur and Fort William, Ont., are connected with a trolley system owned and operated by Port Arthur. The line is 7½ miles long and is managed by three commissioners elected by the people. It paid 2½ per cent. on the investment last year, the dividend being applied to pay the interest on the bonds of the road. The population of the two towns is only 7,000 and is hardly dense enough to make the road pay as well as it should. With additional bonds soon to be issued, the bond issue will amount to $130,000. The fare is five-cent fares and limited tickets are issued to workingmen.

TELEPHONES FOR INDIANAPOLIS.—The Board of Public Safety has made a contract with the New Telephone Company for 41 telephones for city use at an average of about $29 per year each. The Central Union Company offered to contract for $80 per each telephone. The new company also secured the contract to put receivers and transmitters in the patrol boxes at $3 for each box against $5, now charged by Central Union. In addition, the new company takes all the other telephone service in the city, including 32 office and resident telephones for which the city pays. The entire cost of telephones to the city for all purposes under the new company's prics will be $1,783. The contract provides for a renewal from year to year at the same terms for five years; also that the company shall sell its receivers and transmitters to the board at $5 each whenever desired.

THE TEXAS TRUST LAW.—State Attorney Gen. T. S. Smith, of Texas, has filed four quo warranto suits in the District Court at San Antonio, Texas, against the San Antonio Gas Company, the San Antonio Street Railway Company, the San Antonio Edison Company and the Mutual Electric Light Company for the forfeiture of their charters, injunction and appointment of receivers to take charge of each defendant company. The causes were set for hearing on Sept. 13. The plants of the four companies that are defendants to these proceedings were purchased by a New York syndicate a few weeks ago and authority had been granted the new owners by the city council of San Antonio to consolidate the four concerns into one company. Attorney General Smith claims that this consolidation is in violation of the Texas trust law and the proceedings were instituted on that ground.

THE CANADIAN NIAGARA POWER COMPANY.—Before it adjourned on March 30, the parliament of the province of Ontario passed a bill which will make it possible for the commissioners of Queen Victoria Free Park, Niagara Falls, to enter into an agreement with the Canadian Niagara Power Company under the terms of which the company may yield its exclusive right to the development of power in Queen Victoria Park, and receive in consideration therefor an abatement of rent, which is now $25,000 a year, and also an extension of time; also such other terms as may be found necessary or in the interest of the province of Ontario. It is also provided in the bill that if such an agreement be made with the Canadian Niagara Power Company, the commissioners shall have the right to enter into an agreement with any other person or corporation for the development of power within or without the park boundaries by use of the waters of the Niagara river, with the understanding, however, that this development shall not interfere with the plans or works of the Canadian Niagara Power Company.

THE INDIANAPOLIS STREET RAILWAY SITUATION.—As anticipated, the court dissolved the temporary injunction and the city is now free to go ahead and perfect a contract with the new street railway company with which it has been negotiating relative to a new franchise. The sentiment is gaining ground that the best thing that can be done for all the pepole is for the city government to grant a franchise to the newly organized Indianapolis company upon the best terms that can be obtained. After years of litigation the city has a prospective chance to make a contract with a responsible company on more favorable terms than are enjoyed by any other city in the country, and that would end litigation and insure

good service and other advantages to the city. The question is really not whether the street railway company can give 3-cent fares and universal transfers at a profit, but whether the city is in a position to force it to do so now on or at any time in the near future. All the existing franchises have, at least, two years to run. A large part of the mileage is covered by perpetual franchises which were granted by county commissioners and boards of suburban town trustees before the suburban territory was annexed to the city. There is at best a basis for a prolonged contest in the courts during which inferior service would be the rule and no compensation would be received for the use of the streets. The terms of the contract between the city and the new company are not yet definitely known, but there is reason to believe it will include 4-cent fares, universal transfers on ten minutes time and a payment to the city in yearly installments of amounts aggregating a million and a half dollars during the thirty-four years' grant.

THE NIAGARA TUNNEL.—Every year the Niagara Falls Power Company make a test of the interior of the great tunnel in order to determine its condition. These tests were recently made, and the result was in every way satisfactory.

INCREASED COST OF RAILWAY CONSTRUCTION.—The Indiana electric railway companies, which have begun extensive operations in construction find that, owing to the operations of the iron, copper and other trusts, the cost of street railway construction this year is $2000 greater per mile than it was last year.

MOTIVE POWER FROM BACTERIA.—It seems that an ingenious Russian engineer has constructed a small motor which is run by bacteria. The motive power is the product resulting from the bacteria, which develop carbonic acid and other gases during fermentation. The inventor, Mr. Mellikoff, is also experimenting with the bacteria of putrefaction, which generate other well-known gases. A pressure of as much as four and a half atmospheres was obtained, and the motor will run without stopping for twenty or thirty hours when fermentation is rapid. It is, of course, merely a curiosity.

TELEPHONE DEVELOPMENT IN THE UNITED STATES.—From the beginning of March to April 4, seventy-three new telephone companies have been incorporated in the country with a capital of nearly $4,000,000. The movement toward free and long distance speech is by no means a plutocratic one, for whereas the Automatic Exchange Company was incorporated in Meriden, Conn., with a capital stock of $250,000, the Jackpot Company, of Kentucky, is satisfied to begin with $70. It is estimated that by the end of next year more than a billion dollars will have been invested in the telephone alone, and that it will give employment to 750,000 people one way or another.

REASONABLE TELEPHONE CHARGE.—Mr. S. C. Whitesell, a lawyer of Richmond, Ind., believes that $2.50 a month is a reasonable rent for an office telephone. He offered to pay that sum to the Central Union Telephone Company for the use of a telephone, but it demanded $3.50 a month. He, accordingly, brought an action for a writ of mandate to compel the company to furnish him an instrument at what he called a reasonable rent. He alleged in his complaint that the total investment of the company is only $7300, from which he alleges that it received a net profit last year of $3,000, which he denominates extortion. The Circuit Court decided adversely to his claim and he has appealed to the Supreme Court.

CONTROLLER CONTACTS.—A patent issued April 4 to Mr. G. H. Condict, relates to improvements in contact fingers, which connect the contact bars of a controller or rotary switch with the various circuits controlled thereby. The several segments on the controller cylinder are separated by disks or partitions of insulating material. The contact bars are not flush with the controlling cylinder, but are elevated above the surface, and the downward movement of the contact finger is limited, so as to prevent it from dropping between the bars when the controller is rotated. The fingers are mounted by pairs on a bracket, and each finger has its own spring, which has an insulated support secured to the finger. The construction is such that the fingers can easily be removed and each finger is provided with a separate conductor, so that the passage of heavy currents cannot injure the fingers or the supporting pins.

GASOLENE ENGINES.—Mr. W. M. Gray, electrical engineer and contractor of Minneapolis, in a lecture to the students of the College of Engineering of the University of Minnesota, March 14, on "Gasolene Engines for Small Electric Light Plants," said that his experience leads him to prefer the "hit and miss" type rather than those that take an explosion at every stroke. The regulation of these engines has been improved so far that no trouble is now experienced from flickering of the lights, at least with engines of twenty-five or more horse-power. The engine is still capable of being improved, the main journals being generally too small to carry the weight of the immense balance wheels without risk of sudden and serious "hot boxes." The other principal weakness of the gasolene engine is its liability to refuse to start, the reasons being frequently difficult to locate and remove quickly. In a number of plants he had installed, the gasolene engines were working satisfactorily. The best field for them is in remote places where transportation is so expensive that gasolene can easily compete with more bulky and heavy fuels. The control of the gasolene market by a trust is the principal source of uncertainty in the use of such fuel.

GRANULAR TELEPHONE ELECTRODES.—In a patent issued to Paul W. Bossart on April 4, for an improvement in granular electrodes, the invention is stated to consist partly in an improved process for treating the granules partly in the granular electrodes themselves and partly in the instrument of which they form a distinctive feature. Each granule making up the microphonic bed consists of a carbon or other non-metallic body, having a roughened surface presenting on every side points or other projections and coated with a continuous metallic film. To obtain the latter, the granules, which are preferably of carbon, are immersed in a bath of dilute sulphuric acid for several days, which produces the required roughened condition. The surfaces of the granules are then moistened thoroughly with an aqueous solution of phosphorus and bisulphide of carbon, and are then immersed in a nitrate of silver solution. The bisulphide of carbon aided by the phosphorus, reduces the silver to a metallic state. A coating of gold, silver or copper is then applied and adheres to the metallic surface, forming a metallic film, the best results being obtained when this film is very thin. According to Mr. Bossart, the microphonic transmitter depends on the electrical conductivity of its granular electrodes and partly on the microphonic distance of the same, and he considers that by coating the carbon body in the manner decribed, a compound granule is produced which secures superior conductivity while retaining the microphonic distance.

MULTIPLEX TELEGRAPHY.—Among the patents dated April 4 are two on multiplex telegraphy, one issued to Prof. Rowland, of Johns Hopkins University, and the other to M. Mercadier, of Paris, France. The former includes no less than 58 claims, and is based upon the use of alternating currents with the plus and minus waves so modified as to produce a system of signals. The apparatus is so arranged as to divide the impulses into groups and then so separate these groups from each other that each may transmit a separate message, thus enabling a large number of signals to be simultaneously sent or received over a single circuit. The invention also embodies a method of maintaining the synchronism between the current-collecting and distributing devices, which consists in driving the apparatus by a motor, the speed of which is regulated by a synchronizing device, whose speed is in turn governed by the alternating signaling current. Another detail is a system of combining circuits so that a comparatively small number may produce a large number of signals. Another detail consists of means whereby the signals when received may be printed directly without the necessity of translation. The invention of M. Mercadier relates to a combination of induction coils, condensers, microphones and an artificial telegraph line. The transmitters consist of tuning forks kept in motion by electro-magnets; each of the forks is tuned to a different note and twelve may be used in musical divisions of an ascending scale of one-half tone. A telegraphic key is in the secondary of the transmitting induction coil, and when this is closed a vibratory current corresponding to that produced in the primary is obtained in the secondary. The remainder of the transmitting apparatus consists of arrangements of condensers, inductances and resistances, and of a microphone, which finally translates the signals to the line. Twelve messages may be simultaneously sent or received. The receivers consist of telephonic devices, each of which is tuned to respond to only one set of signals.

MUNICIPAL STREET RAILWAYS IN DETROIT.—Experts will be employed to go over the books of the Detroit street railway companies separately to ascertain their earnings, expenses and amounts invested. Prof. Cooley, of Ann Arbor, one of the experts employed, will visit each plant, carefully going over and appraising its value. Then he will make his reports to the commission, when the reports of all the experts will be taken together and a valuation set upon the property by the commission. It is believed this will be below what the company organized to consolidate the lines for convenience of transfer will ask, but this, it is stated, will be ignored by the commission and only the original lines dealt with.

STREET RAILWAY CONSOLIDATION IN CHICAGO.—It is reported from Chicago that negotiations are under way for a consolidation of all the traction interests of that city, surface cable, horse and electric and the elevated roads as well, into a gigantic corporation, having a capital of $200,000,000 and controlling over a thousand miles of track in and about Chicago. On a capitalization of $200,000,000, the properties which are making profits would earn about 2 per cent., on the basis of last year's reports. It is understood that the syndicate which would buy the Chicago Traction property is composed of New York, Philadelphia and Chicago men identified with Metropolitan Traction of New York, Philadelphia and other cities.

NON-RESIDENT LECTURERS AT THE UNIVERSITY OF MINNESOTA.—Among recent lecturers before the University of Minnesota have been Mr. W. I. Gray on "Gasolene Engines for Small Electric Light Plants;" Mr. Channing T. Gage, of the American Steel and Wire Company, on "The Manufacture of Copper Wire," and Prof. Morgan Brooks, of the University of Nebraska, on "Finance and Engineering." In the near future, Mr. J. T. Fanning, hydraulic and consulting engineer of Minneapolis, will lecture upon the "History and Development of Water Power." On April 28, Mr. Walter B. Snow, of the B. F. Sturtevant Company, Boston, will lecture upon "The Influence of Mechanical Draught upon the Ultimate Efficiency of Steam Boilers."

CONTROLLING SWITCH FOR ELECTRIC MOTORS.—In two patents issued to Mr. Reese Hutchinson on April 4, a controlling switch for electric motors is described, the object of which is to prevent a careless or ignorant operator from injuring a motor by introducing excessive strengths of current or abruptly varying the current. As applied to a street railway controller, there are two electromagnets, one of which is a relay magnet and the other, actuated by the relay magnet, operates mechanism to lock the controller when a current passes through the motor beyond a predetermined amount. The coils of the relay magnet are in the motor circuit and normally keep closed the circuit of the locking magnet, which latter is thus kept from engaging to lock the controller; when there is an excess of current, the circuit of the locking magnet is broken by the relay magnet, the former is de-energized and locks the controller.

CLAUS SPRECKELS IN ELECTRIC LIGHTING.—The recent announcement in the San Francisco *Call*, which is owned by John D. Spreckels, that Claus Spreckels, the millionaire sugar king, had organized an electric light and power company has caused wide fluctuations in local electric stocks. According to the story published, Mr. Spreckels says that he hopes to free the citizens from paying high rates for light and power. There is much speculation among electrical people as to the details of the new plants to be established. According to the articles of incorporation the Independent Electric Light & Power Company has been organized to exist 50 years, with a capital stock of $10,000,000, of which $5000 has been subscribed. Among the company's purposes are to manufacture, buy and sell electricity, conduct a telephone business and carry on manufacturing. It is said that work will be commenced as soon as the franchise is granted, and an underground system of distribution will be installed in connection with thoroughly modern electric generating stations. The plant will be located on the Bay Shore in the North end. The directors named are: Claus Spreckels, John D. Spreckels, A. B. Spreckels, Charles A. Hug and W. D. K. Gibson, all of San Francisco. It is understood that Claus Spreckels will be president of the corporation. The name of the company's engineer has not been disclosed. An opposition telephone system may, also, be established.

CELEBRATING THE FRENCH CABLE.—A notable ceremony occurred at the Blue Room of the Executive Mansion at Washington on April 8, when the French Amabassador, M. Cambon, presented, to the government and the American people, through President McKinley, two magnificent Sevres vases from the French National Pottery, at Sevres. The gift was from the late President of the French Republic, Felix Faure, and commemorated the opening of the new Franco-American cable, on August 17, 1898, when President McKinley and President Faure exchanged the first message over the new line. The vases and pedestals stand from six to eight feet high, and are of a deep blue, characteristic of the finest Sevres ware, as well as in happy accord with the prevailing colors of the Blue Room. M. Cambon made an address and the President responded. M. Cambon was accompanied by the entire staff of the Embassy and M. Lurienne, of the French Cable Company. The President was accompanied by Secretary Hay. The vases had already been placed in position, one on either side of the large window looking toward the Potomac. They far exceed in elegance anything in porcelain hitherto brought to the White House.

ELECTRIC RAILWAY PATENTS.—A patent dated April 4 was issued to M. Heilmann, of Paris, France, for an electric railway system which obviates the use of controllers on the motor car. Polyphase alternating currents are distributed at a high voltage from a central generating station to a number of substations. In each substation there is a direct-current railway generator operated by a polyphase motor, the current therefrom being sent to a third rail on the line. An aerial trolley connects the car with the substations and enables the substation motor to be controlled from the car. The road is divided into as many sections as there are substations, and a car on any one of these sections regulates its speed by controlling the motor driving the generator which supplies current to that section, each section being electrically separate from the others. On the same date a patent was issued to Prof. D. C. Jackson, of Madison, Wis., on a means of bonding metallic pipes or mains, the object being the prevention of injury to the same through electrolytic action. In the case of pipes, lugs or enlargements are cast at each end and bonds connect across the joint of the pipe. In some cases it is intended that these bonds shall be connected at intervals with a common conductor especially provided for the purpose, or with rails of a street railway system.

ELECTRIC METER.—A patent was issued April 4 to Mr. Gustave A. Scheeffer, on improvements in electric meters having for their object the production of an instrument of greater simplicity and accuracy. The meter consists of an annular or disk-like armature provided with centrally cut slits which, in connection with a mercury contact-making device or commutator, serve to direct the flow of current in the armature, thereby securing its rotation. Two details of the invention consist of means of securing a practically hermetic closure for the meter. This is accomplished by means of insulated leading-in plugs situated in the meter casing to receive the line conductors, the conductor passing through these plugs; and of engaging faces for the base and removable portions of the meter casing which are adapted to form a tight joint when the parts are united—these two methods completing an effective closure for the containing parts. The disk, which is of copper, rotates between the poles of two oppositely disposed permanent magnets and is provided with an annular mercury well formed of two concentrically disposed extensions soldered upon the disk. The disk and the mercury well are provided with slits or saw cuts which extend nearly to the periphery or rim of the disk, dividing the same into twelve equal segments. The same saw cuts divide the mercury well, forming thereby segments of a commutator device, which segments are electrically connected with corresponding segments of the disk. Depending wires connect brushes with the mercury in the well. It will be apparent that the mercury well with the attached extensions forms a commutator, while the segmental disk is in effect a drum-wound armature, so that the current led in from the line and through the armature, is subjected to magnetic fields of force maintained by the permanent magnets, thereby causing the rotation of the meter at a rate corresponding to the current flowing in the circuit. The annular mercury well is purposely constructed of narrow width so that the resistance of the mercury therein is relatively very much greater than the external circuit through the disk armature, and as a result the current is almost entirely directed in its flow from the brushes through the copper disk.

THE TELEGRAPH IN MEXICO.—President Porfirio Diaz, of Mexico, says in his recent message to the congress of that country: "Many new telegraph lines have been put in, and the government has taken possession of the branch line from Tepa to Pichucaclo, in the state of Chiapas. From July to December an increase of 21 per cent. in earnings was shown over the same period the previous year."

FRANCHISE TAX IN MISSOURI.—The Missouri House of Representatives has passed a bill to tax franchises. It names almost every class of business, including incorporated banks, railroads, street railways, telegraph, bridge, ferry, telephone, sleeping car, gas, water, electric light and power companies, and provides that they shall pay the same tax on their franchises as is paid on other kinds of property. An emergency clause was passed so that if the bill becomes a law it can take effect in time for this year's assessment.

THE RIGHT OF A CITY TO REMOVE TRACTION POLES.—In an action by the city of Elkhart, Ind., against the Elkhart Street Railway Company, Judge Wilson, of the Circuit Court, decided that a city has a right at any time to remove a traction company's poles from the street, whether placed there under the terms of the franchise or not, and that the city has no right to discriminate in favor of iron poles as against wood. Several other points are also involved in the ruling. The decision is so remarkable that the company will appeal to the Supreme Court.

ELECTRIC CABS IN PARIS.—Popularity has already been achieved by the electric cabs, which began to ply for hire in Paris at the beginning of last week. The trouble is there are not yet enough to go around. A dozen came out from the Compagnie des Petites Voitures depot on Easter Sunday, and the number has steadily increased every day. The company has a hundred available, which will be on trial for a whole month. They are all moved by electricity. The type at present is the so-called landaulet, carrying four passengers. The fares are very moderate, only a trifle above the regular thirty cents per journey. All this made the cabs instantly popular.

MARCONI'S WIRELESS TELEGRAPH IN FRANCE.—It is stated that the French government is so pleased with the success of Signor Marconi's wireless telegraph experiments across the English Channel that it proposes to have him conduct experiments between the South Foreland Lighthouse, the present experimental station in England, and the Eiffel Tower in Paris, a distance of 230 miles. The heavy gale and rains in the English Channel on April 7 did not affect the transmission of messages by the Marconi system between South Foreland Lighthouse and the station on the French coast. According to a London despatch the messages passed as readily and distinctly as if the weather was calm.

THE PARIS EXPOSITION.—Mr. John H. McGibbons, Director of Exploitation, United States Commission to the Paris Exposition, requests that all who desire to make an exhibit at the Paris Exposition of 1900 shall notify his office immediately. While there are many applications on file in every line of industry, it is desirable that the American sections be not only representative of this country, but also represent the largest possible number of producers. It is even estimated that fully 60,000,000 people from every part of the globe will attend. This Exposition will, therefore, offer an opportunity to greatly increase the foreign trade of the United States. Mr. McGibbons' office is in the Auditorium Building, Chicago.

CUBAN CONCESSIONS.—A Detroit, Mich., despatch states that important concessions in Cuba have been offered to certain Detroit capitalists, among whom are Frank J. Hecker, Senator McMillan, Charles L. Feer, and others interested in the Peninsula Car Works in that city. The deal was arranged through Jose Machado, a Cuban resident of New York, and Dr. A. Arnaud, of Detroit, by Oliver Phelps, of the Peninsula Company. For $1,700,000 the cities of Cienfuegos, Pinar del Rio, Bejucal and Santa Clara are to be supplied with water, and Pinar del Rio is to have a new electric lighting plant and a market. The Detroit men get the contract for a small cash consideration and a very liberal percentage of gross receipts. The New York banking firm of J. M. Ceballos is to float the bonds, which the municipalities will guarantee for a long term. Limay & Company, of Brussels, bought these contracts five years ago, but defaulted during the Spanish war.

GOVERNMENT CONTROL IN FRANCE.—A striking exhibit of the increase of public officials in France during the past fifty years, is made by M. Turquan in the *Monde Economique.* In 1846 the total number of employees of the state was 188,000, and their salaries amounted to $49,000,000. By 1896 the number had swollen to 416,000, costing the national treasury $121,000,000. That is to say, while the population of France has increased 10 per cent., public functionaries have increased more than 100 per cent. A part of the increase is no doubt due to the extension of state control to matters which were left in private hands fifty years ago. But one suspects needless multiplication of offices and the existence of many sinecures. The pay of public servants is not high; the average now being only $298 a year; yet the pressure for places is enormous France has given us the name empleomanie, though, perhaps, she has the disease in no more violent form than Spain, or Italy, or the United States.

A NEW ENCLOSED FUSE.—A patent was issued on April 4 to W. M. Mordey, of England, for an enclosed fuse, consisting of one or more thin wires supported in a glass tube or other suitable vessel or box. The tube is partly or wholly filled with finely divided or pulverized non-conducting material, such as dry chalk, marble, bath brick, sand, mica, emery or asbestos, which material covers and surrounds the fuse wire or strip. A material which Mr. Mordey has found very satisfactory in practice is flue dust, such as is deposited in the flues leading from the boiler fire boxes. A small space is or may be left uncovered by the finely divided non-conducting material at some portion of the tube to enable the position and condition of the fuse conductor to be observed. For large currents Mr. Mordey prefers to use an enclosed fuse of small size in connection with an ordinary fuse or circuit-breaker in shunt with it, the latter being arranged to carry practically the whole current; in the event of an excessive current, the ordinary fuse melts or the circuit-breaker acts, but does so with a scarcely perceptible spark, and the final rupture of the circuit then occurs in the small enclosed fuse.

BETTING ON CALL BOARD NUMBERS.—A special despatch from London of April 8 says: The week's chief gambling was done over the new electric call board erected in the Stock Exchange. Formerly a stentorian waiter shouted out the names of brokers whose clients were waiting outside. Now an experimental board has been erected. It is covered with white ground glass with squares on which are black figures from one to fifty, representing that number of firms. When a brilliant electric light shines behind a figure a representative of that firm knows that a client is waiting. The idle brokers immediately saw speculative possibilities. A bank was formed, and odds at first of 44 to 1 were offered against a particular number. Then it was seen that certain numbers showed frequently, and the odds against them were shortened. A chance on odd and even numbers showing is quoted at even money, but the favorites are mostly odd, and the bookies are now asking a shade in their favor. As the call board is proving a success from the point of view of the Stock Exchange arrangements, its uncertainties are sure to provide constant opportunity for speculation.

NATURAL GAS SUPPLY.—Pittsburg is elated over a statement, made by J. C. McDowell, an expert on natural gas, that it need fear no gas shortage for a quarter of a century. While decreasing pressure in the Indiana fields is a warning that the supply is lessening, the gas-fields in Western Pennsylvania continue to hold up surprisingly well, and to this supply is now added that from West Virginia, where nature has made a supply of the fuel more generous than any heretofore found. "More natural gas is in sight and at hand to-day than there has been for years," says the expert. "The West Virginia wells are expensive, but they are wonders. Gas has been found in four different sands in that state, the lowest being the Gordon sand, which is found at the depth of about 3000 feet. We have one well down there which cost $10,000 to drill and case. It is over 3000 feet deep, and contains more than one mile of casing. My experience with the Pennsylvania fields leads me to believe that West Virginia is good for a 20-year supply of gas, taking into consideration only the territory which is now in sight. In the early gas developments of Pennsylvania the mistake was made of drilling the wells too thickly, which exhausted the fields rapidly. In the West Virginia fields each well is given a territory of 200 acres. This plan undoubtedly increases the total amount of gas that may be obtained from a field."

ENGLISH MUNICIPAL ENTERPRISES.—A parliamentary report on water, gas, street railway, electric lighting, and other reproductive undertakings carried on by municipal boroughs in England, shows that at the end of March, 1898, the total capital invested amounted to £88,152,600, of which £83,379,300 had been borrowed. But of the borrowings, £11,496,100 had been repaid by the boroughs. Average annual income from these undertakings during five years was £8,898,400, and alleged average annual net profit £3,613,700. Data is wanting as to the manner in which the profit is figured.

PHYSICAL QUALIFICATION OF STREET RAILWAY EMPLOYEES.—The Ottawa Electric Railway Company has decided to fix a standard for all applicants for positions on the road, and in future any person seeking employment as a conductor or motorman must first meet the requirements of the standard. Conductors must be at least five feet eight inches tall, 145 pounds in weight, must have sound hearing, heart and lungs, good eyesight without the use of glasses, and must not be crippled in any way, nor have any constitutional disease. They must have a fair education and not use intoxicating liquors. Motormen must meet the same requirements except that they will be required to weigh each 160 pounds. Conductors must furnish bonds for $50.

TELEGRAPH LINE TO DAWSON, ALASKA.—Under date of March 16, 1899, Consul Brush, of Clifton, writes: The Canadian Government has decided to construct a telegraph line to connect the Yukon territory with British Columbia. A party of engineers has left, to commence the work without delay. The plan of the Minister of Public Works is to construct the line of telegraphs between Lake Bennett and Dawson City at once. At the same time, surveyors will examine the country northward from Quesnelle, British Columbia, which is the terminus of the present government system (old Cariboo line), in order to connect with the line to Dawson. The ministers have decided that the franchise for the telegraph line to Dawson is too valuable, and too important from the standpoint of the national safety, to be allowed to go into any but government hands.

WATER POWERS IN ONTARIO.—There will shortly be published in Ottawa, Ont., a map showing the water power available within a radius of 45 miles of the city. An approximate estimate of each power (leaving out small streams of from 10 to 20-hp to be found on every small stream north of Ottawa) aggregates 890,000-hp. This is considered a very conservative estimate based not even on the mean volume of water on each stream, but on a stage between mean and low water. The most important feature of the powers in this district, however, is the fact that the source of supply of each stream rests in large lakes that at a small expense for retaining dams can be converted into vast reservoirs by means of which the powers can be largely increased and regulated during seasons of extreme high and low water. Within 25 miles of Ottawa is the immense water power of the Chats Rapids. It is estimated from regular survey at 120,000-hp and not a horse-power of it is now being utilized.

A NIAGARA AVALANCHE.—One of the greatest falls of rock ever known to have occurred from the Niagara cliffs took place early on the morning of Friday, March 31, when many hundred thousand tons of the bank gave way and fell upon the buildings at the foot of the Buttery elevator and the Gorge road tracks. It was a perfect avalanche of rock that fell, and much damage resulted. The point of the fall was just on the south side of the Buttery elevator, and the mass piled up in a great mountain over and about the tracks of the electric line that skirts the whirlpool rapids at this point. One great solid mass of limestone, weighing thousands of tons, fell on the roadbed of the Gorge road and crushed it out of shape, pushing out the rails toward the rapids. A few feet further and this great rock would have plunged into the rapids and been lost to sight, but there is no doubt that a great quantity of the rock that fell did go into the river. The buildings at the base of the cliff suffered considerably. One of them had just been rebuilt after being wrecked by the fall of an old elevator shaft, torn away from the cliff by the wind, some weeks ago. This building was again destroyed, and about 40 feet of the shaft of the new elevator was also torn away. Soon after another great mass of rock was found ready to fall, and this, by request of the mayor of Niagara Falls, was blasted away. The mass of rock adds materially to the work necessary to get the Gorge road ready for operation this spring.

EXPORTS OF ELECTRICAL MATERIAL FROM NEW YORK.—The following exports of electrical material, machinery, etc., are from the port of New York for the week ending April 8: Antwerp—80 cases electrical material, $5045. Argentine Republic—9 cases electric fans, $289. Brazil—78 cases electrical material, $6804. Berlin—1 case electrical material, $480; 1 case electrical material, $2065; 10 cases electrical material, $350. British West Indies—1 case electrical material, $20. British East Indies—4 cases electrical material, $81. Bremen—2 cases electrical materials, $30. Cuba—34 packages electrical material, $660. Central America—4 packages electrical material, $176. China—16 cases electrical material, $300. Ecuador—15 packages electrical material, $260. Hamburg—50 packages electrical material, $2887; 11 packages electrical machinery, $5951. Genoa—2 cases electrical machinery, $41. Havre—23 cases electrical material, $1354; 25 cases electrical machinery, $150. Japan—16 packages electric cranes, $2525; 84 packages electrical machinery $6082; 8 cases electrical material, $184. Krementcburg—85 boxes electrical machinery, $13,648. Liverpool—44 packages electrical material, $2889. London—80 cases electrical material, $6091; 5 cases electrical material, $190. Mexico—133 cases electrical material, $1869. Nova Scotia—1 case electrical material, $34. Nice—61 cases electrical material, $19,093. Newfoundland—1 case electrical material, $17. Oporto—25 cases electrical material, $5957. Siam—3 cases electrical material, $4. Southampton—18 packages electrical machinery, $202. Stockholm—4 cases electrical machinery, $400. U. S. of Colombia—2 cases electrical material, $34. Venezuela—53 packages electrical material, $240.

LETTERS TO THE EDITOR.

Application of Alternating Currents to Electric Railways.

To the Editors of Electrical World and Electrical Engineer:

Sirs—Referring to the editorial in your issue of March 18, concerning the Hunter patent on the application of alternate currents to operate electric railways, the patent referred to will not bear the broad interpretation you place on it. The claims quoted in your editorial and in the patent digest seem to be limited, in view of a patent granted to the writer, No. 509,512, dated Nov. 21, 1893, which was applied for some ten years ago, and before the Hunter application. The Patent Office drawings were actually made early in 1886, as the records show. About that time the subject was canvassed by Siemens, Westinghouse, Ries, Van Depoele and the writer, all of whom subsequently made application for patents.

JOHN C. HENRY.

DENVER, COL.

Double Current Generators.

To the Editors of Electrical World and Electrical Engineer:

Sirs—On page 311 of your issue of March 11 is a letter from Mr. R. M. Hunter respecting double-current generators.

Referring to the article on this subject that appeared in THE ELECTRICAL WORLD of March 4, Mr. Hunter states that he built a combined alternating and continuous current generator in his laboratory in the early part of 1894. He mentions this case as evidence that the design of this type of machine was known in this country prior to its use abroad.

In this connection I should like to cite the following facts: In the Westinghouse exhibit at the World's Fair in 1893, there was a double-current generator which supplied direct current at 500 volts and alternating current at 3000 alternations, for operating different parts of the exhibit.

In December of the same year the Westinghouse Company furnished the Citizens' Light and Power Company, of Rochester, N. Y., three double-current generators, to be used for supplying either direct current for power or alternating current through raising transformers for lighting. The Rochester plant was described in THE ELECTRICAL ENGINEER of March 21, 1894.

W. M. PROBASCO.

PITTSBURG, PA.

220-Volt Lamps.

To the Editors of Electrical World and Electrical Engineer:

Sirs—Mr. A. D. Page in your issue of March 25 says in reference to the manufacture of 220-volt lamps, that the great obstacle to furnishing a high-economy 220-volt lamp is the impossibility of making all lamps of exactly any given voltage. Now there would be no material objection, so far as smooth economical running is concerned, to the running of our plant at Lake City, at a voltage a little higher or lower than 220 volts. That is, if any inducement were offered us by the lamp manufacturers, we would produce a voltage of 215, 225 or even of 230 at the lamps.

In all the correspondence I have had with lamp manufacturers, in reference to furnishing higher economy lamps, such a thing as using a higher or lower voltage lamp has not been hinted at. Since I wrote my previous letter I have received an offer from a prominent manufacturer to furnish a 3.5-watt 220-volt lamp with a full guarantee as to life, initial and maintenance of cp, economy and non-short-circuiting. Mr. Page says: "When the customer is on the contract basis he has nothing to gain and much to lose from the use of high-economy lamps and dissatisfaction would certainly ensue." It is true that he has nothing to gain unless the station manager will allow him the benefit of part of his saving of 15 to 20 per cent. in current, by giving him better attention, and furnish part of the renewals free or only make a nominal charge for them. Mr. Page suggests making a charge of 10 cents per lamp and keep down the average life "pulling in" the dim lamps. I think a better plan would be to make a charge of 30 cents (about 25 per cent. above cost), and then furnish free only such lamps as fall below the average in life and maintenance of candle-power, which would not amount to over about 25 per cent. of the total number of lamps furnished.

Merrill H. Fisher.

Lake City, Ia.

Two-Phase vs. Three-Phase Systems..

To the Editors of Electrical World and Electrical Engineer:

Sirs—Referring to your editorial on "Two-phase versus Three-phase Systems," no one, I think, in the present state of engineering can strictly adhere to any single system, irrespective of local conditions. As a doctor would never apply one single remedy to all complaints, so the engineer can never cling to one particular system for all places and all times.

The three-phase system is primarily a transmission system; the two-phase system is a distributing system, and the question as to whether alternating or direct currents should become the result of transformation depends entirely on local conditions and requirements.

W. S. Barstow.

Brooklyn, N. Y.

To the Editors of Electrical World and Electrical Engineer:

Sirs—Without going into the technical discussion of the matter of two-phase vs. three-phase, I may, however, state that for the past three years The Royal Electric Company, of Montreal, has been serving, by means of a two-phase system, from 70,000 to 75,000 incandescent lamps and about 750-hp in alternating current motors. The motors have been supplied from the same source of power and from the same distributing circuits as the lights and we have been able to serve these number of lights and motors with practically the same ease and with as good results in regulation and distribution as we were previously able to serve light from our single-phase system.

P. G. Gossler.

Montreal, Canada.

To the Editors of Electrical World and Electrical Engineer:

Sirs—Referring to the editorial in your number of March 18, on two-phase vs. three-phase systems, it would seem that the conditions under which each is best used are fairly clear.

For a transmission plant intended only for power purposes, the three-phase system undoubtedly has the advantage. For short transmissions, where the load consists of both light and power, the two-phase system has the advantage, and for a long transmission with mixed load, two phase-generator, three-phase transmission and two-phase distribution is better adapted.

In regard to synchronous converters, your remarks as to the need of further information are certainly pertinent. Using six leads to converter on the three-phase system is an advance, as also is an arrangement, recently devised, by which compounded converters working in parallel on their A. C. side and independently on their D. C. side, are made to regulate automatically their D. C. voltage without varying the A. C. voltage applied to the remaining machines. Certainly little information is available as to the causes of hunting in speed, variation of synchronizing current, etc., referred to. That wave form plays an important part in the phenomena there can be no doubt.

I am at present having special machines constructed, each to give e. m. f. waves of a number of different shapes, with which I hope to throw some further light on the subject.

R. B. Owens.

Montreal, Can.

The Cost of Speed in Rapid Transit Service.

To the Editors of Electrical World and Electrical Engineer:

Sirs—The subject of train operation treated in the article by Mr. Cravath in your issue of last week, is so broad and involves so many important features other than acceleration, that it is very difficult to properly present the subject from a single assumed basis. As found in practice, stations are not a uniform distance apart and the difference in distance may be so great as to call for a maximum speed on the longer distances much greater than could be attained with the same equipment over the short runs.

Very high schedule speeds, unless accompanied by relatively rapid acceleration to correspondingly reduce maximum speed, may actually reduce the carrying capacity of a given line owing to the greater headway that must be maintained between the trains as a matter of safety.

While the maximum rate of acceleration can only be attained by an equipment of motors on every car, there are some advantages in the use of the locomotive motor car, not attained by a train equipped with motors on each car. Assuming the condition of maximum schedule that can be safely attained during hours of heaviest service at time of minimum headway, it might be a distinct advantage to increase the schedule speed during hours of lighter service when the headway between trains would render such increase permissible. As the trains at such time would naturally be composed of fewer cars, the use of the motor car would permit the increase in speed, as the power would be in excess for the given weight to what it was in the case of the heavier train. With motors on every car, it would make no difference whether the train was composed of 2 or 6 cars. The power per car would be the same, and the schedule would therefore be fixed independent of the weight or headway of the trains.

I do not think any definite method or system can be laid down that will be the best for all cases, but believe on general principles that the train equipment should be as simple as possible and composed of as few parts as are essential to the particular service.

If the requirements call for motors on every axle, there is no question as to the advisability of so doing. Should the conditions be sufficiently easy to permit the use of a single motor car, such would be the more suitable equipment.

Apart from the relative power consumption, maintenance of apparatus, initial cost, etc., are the local conditions of terminals, grades, relay switching, etc., which modify the requirements of the equipment and render the subject in the abstract so complexed that in our experience it has resolved itself into a careful study of each particular instance. Mr. Cravath seems to have covered the subject very creditably so far as the points considered go.

W. B. Potter.

Schenectady, N. Y.

To the Editors of Electrical World and Electrical Engineer:

Sirs—I have read with great interest Mr. J. R. Cravath's article relating to the economies of acceleration. His statement of the cases he assumes, is in perfect accord with the experiments made on this question of acceleration. He draws attention to the lack of efficiency in slow acceleration. This must necessarily be so for the reason that the increments of speed given the motor are due to the increased potentials at its terminals; the rest of the line voltage being lost in resistance in series with the motors accelerating, consequently the longer the period of operating these motors with resistance is prolonged the lower will be the efficiency of the finally

attained speed which, on a level track and with constant car weight and voltage, will be fixed. The acceleration of a car is due to the equating of the train resistance against the torque of the motor, the torque of the motor being dependent upon the current flow and the motor characteristic. It is also evident from Mr. Cravath's paper that in the multiple-unit system if one motor on a unit could be arranged to maintain only the speed that requires several motors to attain, the gross efficiency would be improved. It is well to keep this modern problem of traction before us in its simplest terms.

Mr. Cravath has certainly investigated the internal economies of acceleration for different methods. In looking around in nature for the ideal acceleration, we find it in the pendulum, where a weight passes from zero speed to maximum acceleration and then to zero. A train starting from one station and stopping at another station at a fixed distance apart under ideal acceleration conditions will, at each moment, present a speed as if the train were swung on a pendulum of a calculable length. Of course, this ideal has divorced from it all elements of appreciable friction, which is the principal factor to contend with in acceleration. But nevertheless elements of this principle can be applied to acceleration by so arranging the grades between stations where possible, and sloping the grade away from the station to reduce the energy of acceleration, and decrease the time to gain maximum speed; the train then on arriving at the next station will store in potential energy what would be lost in heating and grinding the brake shoes, and this can be recovered again on the second start. The formation of these grade changes could be such that the maximum efficiency of energy restoration could be made. The difference of each foot of elevation towards the station in a 95-ton train would be the equivalent of storing 190,000-foot pounds, which would relieve the motors in accelerating, and relieve the brakes in braking.

The automatic method of controlling, in connection with the throttling device, the delivery of current on the multiple-unit system to a motor in acceleration, has shown it to be an economical method, yet an automatic control of acceleration is a clever compromise of all the conditions met with throughout the train route and traffic conditions. The throttling of the current limits the maximum flow, for when the grade or extra train weight, due to passengers, is added, the time to reach maximum speed acceleration is prolonged.

There is a possible solution for some of these acceleration problems external to the equipment itself, such as disconnecting the acceleration portion of the third rail from the feeder section and accelerating through a booster, which would transform the watts otherwise lost in the rheostat into current which could pass directly to the motor for acceleration purposes. Another suggestion would be to put the resistance now in the rheostat into determined sections of the third rail so that the progression of the train would determine the regulating energy delivered. There is another possible solution to this problem in a variable traction effect. If we could operate one of the motors under a two-motor multiple-unit free to revolve, in series with the second motor which is stationary, and connected directly to the axle of the drivers, it can be seen that if a pair of drivers are revolving with this free motor, and the weight of the car gradually is transferred to these free drivers, which by application of this weight come in contact with the rails with a tractive effect, we have the active inertia of the moving motor to assist in overcoming the static inertia of the train. As soon as this motor is reduced in speed the flow of current is increased and the other motor will have an effective torque by increasing the weight on these drivers by hydraulic or other methods. In this way can be substituted the counter electromotive force for the resistance in the rheostat without any controlling arrangement except the variation of traction of the free drivers.

A practical man can see a number of objections to several of these methods, but traction problems are focusing on any methods which can reduce in any way the cost per car mile and the reduction in time between stops.

Albert B. Herrick.

New York, N. Y.

The Relation of the Hardware Trade to Electrical Supplies.

To the Editors of Electrical World and Electrical Engineer:

Sirs—The members of this company have been much interested in the article which appeared in the *Iron Age* of December 22 last, with regard to the handling of electrical supplies by the retail hardware dealer in smaller towns. As we have discussed this matter rather fully amongst ourselves, the writer feels tolerably familiar with the subject; and is very pleased to note that your paper, with its usual enterprise, calls the attention of the electrical trade to this matter and opens its columns for a discussion of the subject by your readers. We are prepared to agree in the main with the writer of the article in question and also with Mr. Gorman, of the Manhattan Electrical Supply Company, as quoted in your columns; as our experience has been that, as far as our line is concerned the hardware dealers in the smaller towns and cities are very satisfactory customers.

Another very vital matter from the manufacturer's standpoint, is, that it is much easier to obtain information as to the financial responsibility of the hardware dealer, than as to that of the electrical dealer or contractor.

This point, which was touched upon very strongly in the original article, was not mentioned by Mr. Stacey or Mr. Roberts in their remarks printed by you on March 23. We will ask Mr. Stacey or Mr. Roberts to turn to either Bradstreet's or Dun's reference books and look up, say, a dozen of their contractor customers, in the smaller towns, and we think that they will find that the majority are either unworthy of credit upon a basis of capital invested or they will be unable to find any mention of their names. On the other hand no town with an electric light plant is without one or two hardware dealers possessing an established credit, and whose worth can be determined by simply referring to either of the reference books mentioned.

We think that the selling of electrical supplies and the doing of contracting work, should be two separate and distinct branches of business, and all electrical jobbers and manufacturers should do all in their power to aid the separation of these classes of trade. The writer thinks that Mr. Stacey has not given the matter very deep thought, as there is just as much logical reason for the hardware man being required to build a house with his wares, as there is that the man who sells electrical supplies should also install them.

The selling of the articles needed in wiring a house is just the same as selling the locks, sashes, fasts, etc., etc., needed in a house. No one expects the hardware man to know how to hang a door or install any other article he sells, although just as much technical knowledge of a different kind is needed in applying hardware properly as is needed in making an electrical installation.

The contractor should occupy exactly the same situation in the electrical field, that the builder does in the application of hardware to its ultimate uses. The contractor has enough details to employ his time and attention without attempting to carry on a merchandising business, and very often when he attempts both lines, they both suffer. If he has important contracts under way they need his attention, and his other business suffers, as it is generally wholly neglected until the rush of the contract is over. The man who devotes his entire energies to keeping posted on where to buy the articles needed by his trade can buy to better advantage than the man who is busy most of the time in a totally different line of work.

The contractor should order his supplies from the local supply dealer, whether this dealer is exclusively an electrical man or also a hardware man. The dealer would then see that the supplies were bought to best advantage, and were on hand when needed, relieving the contractor of what is now a very troublesome part of his duty. The hardware man with an established rating could often have shipments made more promptly that the average contractor, as in these days of small profits every one selling must be sure of the financial standing of his customer or delay the order by asking for references or permission to ship on a cash settlement basis.

Mr. Roberts, the writer believes, has taken an altogether wrong view of the article under discussion, and appears to be antagonistic to the scheme because he appears to think the article was an argument for the hardware jobbers to invade the field in opposition to the present established electrical jobber.

After reading the article over carefully, we can see no argument of this nature, the whole thing appearing to be an appeal to the retail hardware man to add a line of merchandise, which is not now properly handled in many places. It is true that some general remarks are made that the electrical jobber is at a disadvantage as regards selling expenses, as his entire expense falls upon one line of merchandise, while with the hardware jobber the expense is

divided amongst ten or a dozen distinct lines, many of them sold to entirely different classes of trade. At the present time the competition of the hardware jobber need not trouble the electrical jobber, as the writer doubts if there is a single representative hardware jobber who pays any attention to the electrical supply business.

Mr. Roberts admits that many of the customers of electrical supply houses, are hardware men, and the writer cannot help thinking that Mr. Roberts will agree with the article on further consideration, and do all in his power to strengthen his alliances with the hardware retailer, and thus strengthen his position, should the competition of the hardware jobber develop in the future. The writer of the *Iron Age* article expressly refrains from predicting the sources through which the retailer will draw his supplies, and states a general truth applicable to all lines of trade, that the orders will go to the "source from which the retailer can obtain the most prompt and satisfactory service." The thing for the electrical jobber to do is to cultivate the hardware dealer and to make sure that his business is conducted upon a basis which will leave him nothing to fear from the competition of a jobber in any other line.

The electrical jobber has the trade in his own hands, at the present time, and if the tendency is for the supply business to separate itself from the contracting business, he should assist the change instead of combating it, as any individual or set of individuals are powerless to alter, for long, any rearrangement of the lines of economic distribution that is in course of evolution.

This letter is written from a strictly economic standpoint, and the stand taken is in advance of the actual conditions existing to-day. At the present time the business can, in many places, be handled best by the contractor, and where this is true he will continue to handle it until the development reaches a point where it can best be divided.

Many of the points that occur to the writer are touched upon very lightly, and if sufficient interest is shown in the matter by the readers in the electrical field he would be pleased to enter into this matter in detail, as he is sincere in believing that in the future (perhaps many years from now) the electrical supply business will be handled by either a separate dealer in that line where the volume of trade will justify it; or where it will not support a separate establishment, it will be a department of the hardware store.

Whatever the ultimate solution of this question may be the electrical jobber must sell the retailer who serves the local consumer, and the question of who sells the local retailer may well be left for the conditions and time to solve.

The Emerson Electric Manufacturing Co.,
T. M. Meston, Secretary.
St. Louis, Mo.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

Dynamos, Motors and Transformers.

Induction Motors.—Prof. Wilson recently read a paper before the Inst. of Elec. Eng., a brief abstract of which, with some comments, is given in the Lond. *Elec. Rev.*, March 24; the paper is of the nature or an elaborate investigation. His experiments were mainly made to show the action of a particular type of starting device; in this the three rotor circuits are led through slide rings to a triple rheostat while the main and auxiliary windings of the stator are supplied with two-phase currents. From his elaborate experiments he obtained what is said to be an admirable set of tables giving complete records of the current, fluxes, leakage, voltage, torque, etc., but it is stated editorially that these valuable results are almost inaccessible to the ordinary reader for want of clearness of explanation. A diagram gives the probable relative distribution of the magnetic flux at any instant across the air gap, and this agrees approximately with the actual values measured. He shows mathematically that with simple sine currents of any number of phases it is possible to obtain a pure rotary field, but if they are not sine curves such a field is unobtainable. He gives the following formula for the torque when at rest: "Mean torque (in dyne-cms) = 10 to the seventh power × (mean watts in rotor circuits) ÷ (speed of field at the air gap)." He showed how to locate the dissipation of energy, mentioning that a large amount of power is lost by the waste field. The variation of the torque over a half period was exhibited in three tables which show that when the rotor resistance has the critical value for a maximum torque, the torque during the period does not vary by more than 11 per cent. from its mean value; for larger or smaller resistances this irregularity is much more marked, being nearly 60 per cent. in one case. Results are also given for the phase difference between the rotor and the stator currents, and these show, among other things, that the currents are farthest out of phase when the starting torque is greatest. He concludes with an examination of the effects of armature reaction. The maximum torque obtained by the complicated gear could not start the motor when on full load, and therefore a friction clutch or similar device must be used. Where these are allowable it is thought editorially to be much simpler to omit the slide rings and resistances and work with closed circuits as a rotor.—Wilson. Lond. *Elec. Rev.*, March 24.

A New Explanation of Armature Reaction.—Mr. Picou recently read a paper of some interest before the International Society in Paris, a brief abstract of which appears in *L'Eclairage Elec.*, March 11; he endeavors to show that the usual conception of armature reaction is not the correct one. The term armature reaction refers to the combined phenomena which lower the difference of potential at the brushes of a dynamo when loaded, as compared with the difference of potential on open circuit but with the same excitation; apart from the loss in the resistance there is another loss which should be explained. Hopkinson's explanation has become classic; he claimed that the shifting of the brushes has the effect of introducing demagnetizing ampere turns equal to those which are included in an angle twice that of the shifting of the brushes from the neutral line. Picou believes that this explanation is not correct, and that there is no relation of cause to effect between the shifting of the brushes and the reaction of the armature. He believes that the observed reduction in the voltage is due simply to the increase of the reluctance of the magnetic circuit which accompanies the deformation of the field produced by the armature current and the object of his paper is to prove this. Experiments were made on a 10-kw dynamo which was well adapted for this, as the machine has auxiliary fields so as to enable it to operate without moving the brushes; moreover, the small air gap of 2.5 mm favors the reaction and makes it easier to measure the desired quantities. By constructing the curves of the difference of potential with and without auxiliary poles, it was found that these curves can be exactly superposed. The armature reaction should therefore not be attributed to the shifting of the brushes, which does not exist in one of these cases. The reluctances are easily calculated in the two cases as is also the reduction of the useful flux which results. The increase in the reluctance is principally in the armature and the pole pieces, that in the air gap being negligible. He calculated these quantities for that machine and found that the increase is such that the useful flux, for the maximum load, ought to be reduced 6.4 per cent. Electrical measurements show 6.3 per cent., which agrees with this. Applying the Hopkinson method of calculation to that machine he found that there should be a reduction of 8.5 per cent., which shows that the agreement is not good. He states furthermore that if the explanation of the demagnetizing ampere turns is correct, the effects should be superposed on each other as the deformation of the field and the increase of the reluctance should exist in all cases; as this is not the case, he claims that the idea of demagnetizing ampere turns should be abandoned.—Picou. *L'Eclairage Elec.*, March 11.

Alloys for Brushes.—According to the *Elektrochem. Zeit.*, March, Mr. Boudreaux recommends an alloy of copper with 0.2 per cent. of bismuth, 0.3 per cent. of cadmium and 1.5 per cent. of antimony, to diminish the friction. The proportion of these is doubled if the commutator is of hard copper and tripled if it is of steel.—*Elektrochem. Zeit.*, March.

REFERENCES.

Improvements in Dynamos.—Brief illustrated descriptions taken from patent specifications.—Guilbert. *L'Eclairage Elec.*, March 18.

Lights and Lighting.

Nernst Lamp.—In a communication from Prof. Elihu Thomson, in the Lond. *Elec.*, March 24, he refers to some experiments made six or seven years ago with the Welsbach mantels from which he concluded that the light was not due to the material being brought to a high temperature by the hot gases of the flame, and that the material did not possess any peculiar property of luminescence except under specific conditions of use. In his opinion the light given off by such a mantel is due largely to the union of the gases taking place within the pores. The material of the mantel itself may be intermediary in chemical changes which result in the oxidation of the carbon and hydrogen of the flame. The calcium light probably involves the same priciple of action, as there is considerable difference in the amount of light when only the tip of the hydrogen flame reaches the lime after the combustion is complete, as compared with that when the lime is brought into the flame where active combustion takes place, it being much more brilliant in the latter case.—Lond. *Elec.*, March 24.

Nernst vs. Arc and Incandescent Lamps.—In the conclusion of the article by Mr. Hall, in the Lond. *Elec. Rev.*, March 24 (see Digest last week), he compares the Nernst lamp with the usual carbon incandescent lamp. He believes that the Nernst lamp will not replace the incandescent in many of the cases claimed by the promoters. It will, however, have an advantage when the question of fittings, conductors and maintenance is taken into account in the lighting of public halls, large rooms, etc., in which there will be an economy which is well worth securing; itemized estimates are given to show this. The price of the automatic lamp is prohibitive for private residences. Other features are also discussed and he concludes that although instances were given of a favorable nature, yet there are many others which point to the fact that the Nernst lamp has a field, but that it is of a more limited nature than has been claimed for it.—Hall. Lond. *Elec. Rev.*, March 24.

Efficiencies of Incandescent Bodies.—In a communication by Mr. Robertson in the Lond. *Elec.* and *Elec. Rev.*, March 17, he states that he found that filaments made of mixtures of various alkaline earths will burn in a vacuum, which is contrary to the statement of Swinton and others concerning the Nernst lamp. The same filament, for the same candle power, requires less energy than when burning in the open air, and the difficulties of the mountings then almost vanish. He believes these bodies are not electrolytes, as they require the same voltage whether alternating or continuous currents are used, and whether in vacuum or in the open air. Such filaments when run at the efficiencies claimed by the Nernst lamp, change so that the initial temperature of the warming process must be raised higher and higher. The production of such lamps is surrounded by many practical difficulties, chiefly in obtaining uniformity. The theory of the efficiencies of such bodies seems quite simple, as he believes it to be purely a question of temperature; a bad heat radiator will require less watts to maintain it at a given temperature.—Robertson. Lond. *Elec.* and *Elec. Rev.*, March 17.

REFERENCES.

Test of 220-Volt Lamps.—A brief reference to the origina. article published in the Digest last week, and giving a few more details; the original report is contained in the *Jour. fuer Gasbeleuchtung* 1.—*Elek. Anz.*, March 23.

Luminous Fountain in Munich.—An illustrated description of the luminous fountain at last year's exhibition in Munich.—Uppenborn. *Elek. Zeit.*, March 23.

Power.

Electric Power in Steel Making.—Cassier's Mag., April, contains a well illustrated article by Mr. Clark pointing out the great advantages of electric power in the works of steel companies, illustrating a number of applications and giving general hints concerning the predetermination of the most advantageous station equipment. The advantages of electric motors have already been frequently pointed out; as an illustration he states that a comparison was made between the relative costs of operating two "drops" (machines for hoisting a heavy ball and dropping it to break up scrap), one of which was operated by an electric motor through 1000 feet of wire and the other by a steam engine through the same length of pipe. The cost of operating the former was 6.2 cents per hour and of the latter 35.4. Although this is an extreme case, it is not an unusual one; it would be even more favorable to the motor if the cost of repairs, attendance, first cost, etc., had been considered. Several illustrations are given of what are claimed to be the best types of modern construction of electric cranes. He advocates the use of the direct current in preference to the alternating, for steel mills, at 220 to 300 volts; it is not practical to go as high as 500 owing to the danger from grounds. He gives some hints concerning the estimation of the power when variable. When 1000-hp or more of motors is installed for intermittent work, such as on cranes, table-rolls, drops, etc., the average amount of power absorbed by them, even with all working, will not be above 20 per cent. of their capacity, but the maximum momentary demand may be as high as 75 per cent. He recommends very highly the use of electromagnets for lifting plates, bars and ingots; in reply to the argument concerning the danger due to the possible failure of the current, he states that a number of such magnets have been in use in several large establishments for several years, and the first accident from this cause has yet to be reported. The saving in labor and time he states is claimed to be almost beyond credence. Some hints are given concerning the designing of a new plant or the remodeling of an old one. He recommends including a storage battery with a 4-hour capacity about equal to that of one of the units; this will cost about the same as the engine, generator and boiler with their foundations, and will do just about the same work, enabling one unit to be dispensed with while the others will be run more fully loaded; the economy will be greater, the maintenance is about the same, and there is the great advantage of the reserve power. A load diagram is given to illustrate the character of a rolling mill load. He does not advocate the sweeping abolishment of reversing engines by electric motors for roller tables, but believes there is no good reason why motors should not be built to take the place of the enormous engines used to drive roll-trains; with a good flywheel and proper speed, better regulation can be obtained, and if used with a storage battery the cost of operating would be greatly reduced.—Clark. *Cassier's Mag.*, April.

Utilization of Blast Furnace Gases.—Some further figures of inest are given by Mr. Witz in the *L'Eclairage Elec.*, March 18. The amount of energy in the gases of a 100-ton furnace is more than 2000-hp, of which only a small portion is used at present for generating steam for the auxiliary engines. It is estimated by good authorities that about one ton of coke is required per ton of iron produced; in one large American furnace it is reduced to three-quarters of a ton. In a table giving the heat units generated, used and wasted in a coke furnace, it appears that one which consumed nearly 100 tons of coke per twenty-four hours wastes in unutilized gases about 340 million calories, which is more than 50 per cent. of that in the coke; the gases used for generating steam are consumed at the rate of 22 cb.m per indicated horse-power hour, the efficiency of which is only about 3 per cent., as analyses of these gases have shown that about 1000 calories are contained in a cubic meter. By utilizing all these gases in steam engines only about 380 indicated horse-power could be obtained from a 100-ton furnace, which suffices for running all the accessory machinery for it. By using these gases in gas engines, however, only 3.5 cb.m of the gas are used for 1-hp hour, and a total of 2381 effective horse-power could be obtained from the 8333 cb.m of gas instead of the 380-hp possible with steam engines, leaving a difference of about 2000-hp. Gas engines are now being introduced experimentally in connection with a number of blast furnaces and their success is said to be as great as was expected. The difficulties concerning the dust which the gases contain, have not been found serious. Gas engines are now made of 200 and even 1000-hp, the latter for double sets of cylinders. He suggested utilizing the remaining 2000-hp for running central stations, distributing the power electrically. A set of such furnaces is considered as valuable a source of power as a large water fall.—Witz. *L'Eclairage Elec.*, March 18.

Electric Power in Agriculture.—A brief abstract of a recent paper by Renaud from the *Bul. Soc. Enc. Ind. Nat.*, January, which is said to be an extensive and valuable paper on the applications of electrical engineering in agriculture effected in Germany, and on its future in France, is given in *Science*, March 31, and in the *Eng. Mag.*, April. The conclusions are given in the former and are all favorable, but contain nothing new. It seems that much progress has been made in Germany in this direction, wind, water, petroleum and gas being used as motive power; the use of producer gas is claimed to give a horse-power at about half the cost of the fuel as compared with steam engines, and requires less careful supervision.—*Science*, March 31; *Eng. Mag.*, April.

REFERENCES.

Utilizing the Force of the Rhine.—An abstract with some data of the article in *Genie Civil*, recently noticed in the Digest, describing a proposed complete utilization at a succession of points, of the water

power, the installations being undertaken by the Swiss government.—*L'Eclairage Elec.*, March 18.

Electric Motors in a Machine Shop.—A brief abstract of an article giving what is said to be an excellent account of the arrangement in the machine shop of the Allegemeine Elektricitaets Gesellschaft in Berlin, from the *Zeit. ver Deut. Ing.—Eng. Mag.*, April.

TRACTION.

Suburban and Metropolitan Electric Traction.—A paper was recently read before the Society of Arts by Mr. Dawson, a reprint of which in full, is begun in the Lond. *Elec.*, March 24. The object of the paper is to investigate in a general way the special requirements for the rapid transportation of large crowds from and to the business centres, and to show the special adaptability of electric traction to it. The only solution is by overhead or underground railroads; the average speed must be increased as much as possible without diminishing the distances between two trains. Steam locomotives have probably reached their approximate maximum development, and the results obtained with them for this traffic are far from satisfactory; they do not get up speed rapidly, are not economical and their maintenance is costly. There is a commercial limit to the distance beyond which it will not pay to transmit the power electrically, and that limit varies with each case. The examples in his paper are practically confined to American experience. He classifies the various systems but limits himself to the use of conductors laid along the track, to the use of polyphase currents at the power station, and to the case of short runs with frequent stops; the use of polyphase motors is not considered, as for frequent starting or stopping they have not up to date proved satisfactory. The importance of rapid acceleration on lines making frequent stops is discussed. On the tracks at Schenectady it was found to be feasible to reach 30 miles an hour ten seconds after starting. The important point is to obtain a high average speed and to keep the maximum speed as low as possible, as less power is then required for braking and for running the train. The time between the moment when the maximum speed is obtained and when the brakes are put on, should be at least four to six times that required for stopping the train. On the Manhattan line in New York, where steam locomotives are used, it takes twenty-seconds to attain a speed of fourteen miles an hour, or less than half the speed in double the time, as compared with electric traction. A larger current will be required for rapid acceleration for a much shorter time and the total energy will be less; but the motors will be larger and there is therefore a limit above which it is not advantageous to increase the acceleration. By properly grading a road up to a station and down from it, an economy of 40 to 50 per cent. in the total power may be obtained. Potter found that during acceleration an average of 32 amperes per ton of weight of train was required. With one motor car and two trailers weighing complete 148,000 pounds, a maximum horizontal effort of 9750 pounds was required for acceleration, the current being 780 amperes at 500 volts; the maximum speed was 32 miles an hour acquired in 34 seconds with two motors of 200-hp each. In another case with one motor car and trailer, total weight 103,000 pounds, with two motors of 125-hp each, the maximum speed was 31 miles attained in 37 seconds with 500 amperes and a horizontal effort of 5640 pounds. On the Nantasket Beach line a heavy motor car 51 feet long, carrying 100 passengers, weighing 31 tons, and an average distance of 2980 feet between stations, a maximum speed of 40 miles was attained, the average speed being 18 miles per hour and the power required 0.098 units per ton-mile. With one motor and trailer weighing 57 tons, at 4280 feet between stations, a maximum speed of 37 miles was attained, the average speed being 17 miles and the power 0.067 units per ton mile. A comparison of the lines in Chicago and London shows that the maximum speed of 25 miles an hour is attained in ten seconds with electric traction, and it requires 33 seconds to do it with steam locomotives; with electric traction the distance of 1880 feet is covered in 66 seconds, while with steam it takes 93. Various tables are reprinted, but are not referred to in the text. One gives the data for motors, another the current consumption on the Chicago line, another some preparatory data for various roads and another the power and time to run 2000 feet at 16 miles per hour.—Dawson. Lond. *Elec.*, March 24.

Rapid Transit in Dense Centres of Population.—In an article by Mr. Lundie in the *St. R'y Jour.*, April, he discusses the elements of the transportation problems in cities, referring especially to the prime requisites for any service, such as fare, frequency, comfort and speed. He states that the elevated railway service in New York City, for example, has no advantage whatever over the surface railway service in the elements of fare, frequency or comfort, so that speed only is the one thing which the elevated system can give to the people of New York which cannot be obtained from the surface cars. He points out the fact that there are two methods of obtaining an average running speed; first, the method of accelerating up to the point of braking, and, second, that of accelerating as rapidly as possible to a point above the average speed, and then either coasting or holding this speed to the point of applying brakes. In determining the solution of any given transportation problem, such as that which now confronts the New York elevated system in its determination to change to electricity, a most careful study of all the conditions is necessary, and the relative investments required for obtaining different running speeds together with the operating expenses for those running speeds, must be determined beforehand in order that the most economical selection can be made for practical work.—Lundie. *St. R'y Jour.*, April.

Formula for Train Resistance.—Mr. Carus-Wilson, in the *St. R'y Jour.*, April, claims that Mr. Lundie, in suggesting such a radical change in formulæ for train resistance, as that recently described, should have given more details of his tests, and he does not believe the results given by him justify the formula. He also thinks that the number of cars per train exercises an important effect on the result and that the resistance in pounds per ton is less for heavy trains than for light. In another letter the chief engineer of a large steam railroad company states that in some tests made by him he found that an engine could not draw as many tons of light as heavy cars.—Carus-Wilson. *St. R'y Jour.*, April.

Receipts Per Capita and Mile of Track.—The *St. R'y Jour.* for April, publishes a table showing for each of the principal cities of the United States having more than 100,000 inhabitants, the street railway mileage and gross receipts of the lines, and the gross receipts per capita and per mile of track. The gross receipts per capita range from a minimum of $3 to a maximum of $13.38; per mile of track they are $5,855 as a minimum to $33,199 as a maximum.—*St. R'y Jour.*, April.

Motor Dynamos or Accumulators.—In the *St. R'y. Jour.*, April, Mr. Adams argues in favor of the motor dynamo for a booster instead of the accumulator; the latter requires the purchase of land and attendance; the average efficiency is 85 per cent., so that 1.17-kw must be put in it for every 1-kw taken out. Assuming 20 per cent. loss in the feeder and 500 volts on the trolley wire, the efficiency of transmission from the station to the trolley wire at average load, is 70.7 per cent. with the battery and 80 per cent. without the battery. If the maximum load is twice the average load, the size of the booster in a station without a battery will have to be four times the size of that of the booster for the battery, but the efficiency of the system is not affected by this condition, as it is based upon the average load in each case.—Adams. *St. R'y Jour.*, April.

Resistance of Rails.—In the *St. R'y Jour.*, April, Mr. Goto calls attention to a table of the electrical resistance of rails in an article by Mr. Herrick in the December issue, and states that his own tests give a different result. Mr. Herrick acknowledges the correction, the resistances as given in his table being for single track instead of single rail, as stated. He also states that the resistance of steel rails decreases about 0.48 per cent. for each deg. Cent. increase; also that an increase of carbon in the rails increases their resistance.—*St. R'y Jour.*, April.

The First Electric Express Train in Europe.—Under this title, Mr. Schmitt, in *L'Elec.*, March 25, gives a very brief description of the train which was started last December, running between Duesseldorf and Crefeld in Germany. It is claimed that this is the first case of such a train being run (presumably referring to Europe alone); the speed is said to be very much greater than that heretofore obtained. A speed of 33 to 36 miles per hour can easily be obtained, the normal being 24. The line was erected by Siemens & Halske Co. The overhead conductor system is used, the trolley being replaced by the well known form of contact bar. The car has a single motor of 40-hp; it is mounted directly on the axle, thereby obviating the use of gearing; the car carries fifty passengers. The overhead line is constructed of two wires 9-mm in diameter, both of which carry the current (presumably this means that they are in multiple, and not that one is a return circuit). The length is 22.2-km (12.3 miles); both passengers and freight are carried; the train runs every hour; there is one intermediate stop, and the time of the trip is about half an hour.—*L'Elec.*, March 25.

Proposed Railway Up Mt. Blanc.—The project of Fabre is briefly described in *L'Elec.*, March 25. The line is to start at Houches in

the Chamonix Valley, and is to pass as a tunnel under a ridge to avoid the glaciers, to a point about half way up; no engineering difficulties are expected along this part of the line. The rest is also to be a tunnel to a rocky prominence called Les Petits-Rochers-Rouges, about 800 feet from the top. It is to be a rack and pinion line; the total length is six miles and the total cost about two million dollars; the cost of the tunneling is estimated at about $100 per meter, the line being almost entirely in a tunnel.—*L'Elec.*, March 25.

Progress of Electric Traction in Switzerland in 1898.—Mr. Rochat, in the *St. R'y Jour.*, April (Int. Ed.), gives an account of recent progress in that country. Thirteen lines have been put in operation in Switzerland during 1898 with a total length of 46.6 miles, making the entire length of electric railways and tramways now in operation in Switzerland 104 miles. Detailed information of these roads is given in a table, with references to some of the most interesting features of each installation. The Zürich-Höngg line was the first line to use vestibuled cars. The Aubonne-Gimel line was the first to use maximum traction trucks. The Rolle-Gimel line, the Neuchatel-Port-Gare and the Chaux de Fonds lines employ an emergency brake in steep grades similar to that in Fribourg, described by the author in that journal for March, 1898. The Geneve-Veyrier line employs on the trolley cars a magnetic brake in which the shoes are attracted to the wheels magnetically. The Stanstadt-Engelberg line, the Görnergrat Mountain Railway and the Jungfrau Mountain Railway are equipped with three-phase motors.—Rochat. *St. R'y Jour.* April.

Light Railways and Tramways in Austria During 1898.—In a short article Mr. Ziffer, in the *St. R'y. Jour.*, April (Int. Ed.), he attributes the slow development of these railways in Austria to political conditions which have deterred the investment of private capital. The tramway franchises in Vienna are not yet entirely settled on account of a disagreement between the city magistrates and the government, regarding tax exemptions granted; preliminary concessions for the construction of 26½ miles, however, have been granted. He discusses the tramway conditions at Prag, Brunn, Olmutz, Triest and other cities. At the end of 1898, there were in Austria fifteen electric railways with a total length of 48 miles, and a list of which is given. The present outlook for the construction of "localbahnen" is extremely good and owing to a recent act, passed Dec. 21, 1898, 515 miles of track is proposed.—Ziffer. *St. R'y Jour.*, April.

Report of the Glasgow Tramways.—A report by Mr. Parshall on the proposed electrical equipment of the municipal tramways of Glasgow, is reprinted in the *St. R'y Jour.*, April. The company has in operation 380 horse cars and 27 electric cars. The report is based on the operation of 600 cars, the number thought to be required for the traffic at present. The average consumption of power per car at present is 7.2-kw, and this being taken as an average, gives 5800-hp as the average load and 9250-hp as the maximum load. He recommends the installation of a station of 17,000-hp, including margin for extensions; for the maximum voltage drop on the return circuit he recommends 3½ volts. This would require either five continuous current stations or one three-phase station with five substations. The advantages of the three-phase system over continuous current distribution system are discussed; they are, less capital expenditure in buildings, plant and real estate, less working cost, greater flexibility and quickness in construction. He recommends the use of four generating units, three for operation during normal conditions of load and a fourth for emergency. These units should consist of three-crank tandem compound engines operating at 75 r. p. m. with large flywheels, direct connected with three-phase generators with rotating magnets and stationary armatures and of 6500 volts. The pumps, etc., should be electrically driven. The lighting and tramway power station should be kept separate because, first, the maximum loads in both services occur at the same time on many days of the year, so that the same total capacity in the plant has to be provided whether or not the supply is from a common station; second, as a tramway plant is worked at its greatest capacity three or four times as many hours in the year as the lighting plant, it should be of a more substantial type; third, because the machinery is absolutely different; fourth, the machinery must be run differently, as close regulation is required for lighting machines; fifth, the business conditions of the two kinds of electric supply are different, as current for railway work can be supplied from four to five times cheaper than that for lighting; sixth, a different class of attendants is required for the two stations. In only two prominent cities has an attempt been made to combine both services, one at Toledo, U. S. A., and the other at Hamburg, Germany. He points out that the conditions existing in these two cities do not apply in Glasgow. In an appendix he gives a comparison of the cost of construction, including buildings and plant, between a three-phase generating station with converting substations and a system of several continuous current generating stations. The first consists of four 2500-kw with five substations, and would cost £316,000; the second consists of five stations of 2000-kw, each consisting of four-kw units, and would cost complete £390,000. Following this estimate is one of the comparative cost in pence per kw hour and delivered to the car, on the basis of 600 cars running for 16 hours per day, with 200 of these running between 4 and 5 hours additional per day, making an average of 7.2-kw per car. For the three-phase system the total cost is .5305 pence, not including depreciation on feeders amounting to .019 pence; for the continuous current station the cost of .7367 pence. These figures do not include interest on the cost of real estate.—Parshall. *St. R'y. Jour.*, April.

Power Station and Repair Shops of the Cleveland Railway.—The *St. R'y Jour.*, April, contains a long, illustrated description. This company has recently installed a vertical compound engine with cylinder dimensions 40 inches by 68 inches by 60 inch stroke; the speed is 75 r. p. m. with initial steam pressure of 10 2-3 atmospheres and it is direct connected to a 2400-kw generator, having 22 poles and an armature 14.3 feet in diameter. The flywheel of the engine is 25 feet in diameter and weighs 160,000 pounds. The engine is capable of working up to nearly 5000-hp for short periods. The boilers are of 264-hp each and are equipped with "chain" grates. The main steam pipe is supported on rollers; the coal is handled automatically. The engine is run non-condensing because the exhaust steam is sold to the owners of a neighboring salt mine. The station in the rest of its equipment illustrates the evolution of power station engines, as a number of old engines operating small generators are still in use. The principal repair shop is on the outskirts of the city. The company has recently ordered fifty open cars 34 feet long and fifty closed cars 28 feet long. Reference is also made to a hoist, consisting of a frame of wood, raised and lowered by screws placed under each corner of the frame; the screws are driven in unison by gears so that the car body can be raised from the truck. When not in use the top of the frame is level with the car floor.—*St. R'y Jour.*, April.

Algiers.—The local suburban railway operates about 107.4 miles, mostly by steam, but in 1897 was authorized to equip 9.7 miles with electricity; the latter is described, with illustrations, in the *St. R'y Jour.*, April. Cars are run every five minutes, each motor car drawing a trail car. The climatic conditions are extremely unfavorable for machinery, as in summer the wind is laden with dust which penetrates the bearings and in winter the country is subjected to tropical rains; as a result, the cars often have to run for a considerable distance in 20 inches of water. The track in the centre of the city is laid with Broca rail weighing from 73 pounds to 89 pounds per yard. Metal ties, 39 inches by 3.9 inches are used 6 feet 7 inches apart. Outside of the city a Vignole rail, weighing 40 pounds per yard, is laid on ties 2 feet 7 inches apart. The gauge is 3 feet 6 inches. The feeders in the open country are bare wire carried on porcelain insulators, but within the city they are buried, being insulated with paper saturated with asphalt and protected by a lead sheath and outside steel wire armor. In spite of the excessive heat, which in summer is as high as 110 deg. Fahr., the insulation of the cable has remained in good condition. It is doubtful whether a rubber insulated cable would have given such good results. The power station contains two simple condensing engines with cylinder dimensions 19.7 inches by 39.4 inches. The flywheel weighs 26,400 pouids. A cooling tower, having a height of 23 feet, is used for cooling the condensing water. Each engine is belted to a 200-kw generator. The company has thirty motor cars and eighteen trail cars. For the month of December, 1898, 7.8 pounds of coal was burned per train mile and 5.5 pounds per kw hour at the switchboard.—*St. R'y Jour.*, April.

Repair Records in Chicago.—A list of the total number of the different kinds of repairs made upon electrical equipments of the cars of the Chicago City Railway Company, and also the total number of different kinds of repairs made upon the armatures alone, for last year, is given in the *St. R'y. Jour.*, April. During this period this company had in operation 822 motors, and 821 armatures were repaired, 632 of which had to be turned, 58 were grounded, 58 were open-circuited and the rest had various miscellaneous troubles. It was necessary to make 881 repairs to the electrical car equipments, of which 192 were repairs to trolleys, 196 repairs to brush holders, 119 repairs to wires, 217 repairs to armatures and the rest miscellaneous. —*St. R'y Jour.*, April.

Air Brake With Motor Compressor.—The *St. R'y Jour.*, April,

contains an illustrated description of one of the 160 air-brake equipments ordered by the Third Avenue line of New York. The air compressor is of the compound type and is driven by a small enclosed electric motor, the air being compressed to 60 pounds. When the pressure in the reservoir reaches a predetermined amount, the motor is automatically cut out by the controller and rheostat, and the same controller automatically cuts the motor in again when the pressure is reduced below a certain limit. Two new methods of connecting the brakes to the trucks are used. In the case of a short wheel base double truck, an air-brake jam cylinder is placed between each pair of wheels on each truck and the brake shoes are pressed directly against the wheels by a sort of toggle movement. In the case of a maximum traction truck, one jam cylinder is carried on each truck and is connected to the brake shoes through a system of levers.—*St. R'y. Jour.*, April.

Cast Welding Joints in New York.—The method of casting the Falk joints on about 65 miles of the new work on the Third Avenue line is briefly described in the *St. R'y Jour.*, April. In order to enable the cars to operate continuously while the joints are being laid a bridge is placed over each joint; this has tapering ends so that the cars have no difficulty in passing over it without interfering with the joint underneath. The mould proper consists of three main pieces which are bolted together. Before placing the mould in position for the weld the ends of the rails are carefully cleaned and polished by means of a sandblast operated by a gas engine. The article is well illustrated.—*St. R'y Jour.*, April.

New Track Construction in New Orleans.—Some track is being laid with 100-pound T rails; the height is 5¾ inches and the lengths 60 feet. The rails are laid on creosoted ties which rest on crushed stone, which in turn rests on a creosoted plank flooring. This construction is peculiar to New Orleans owing to the spongy soil, and this is probably the heaviest T rail ever laid in the United States for electric railway service.—*St. R'y Jour.*, April.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Synchonizers.—Mr. Lucas, in the Lond. *Elec. Rev.*, suggests the following method, asking expressions of opinion on it. The alternator which is running is connected to one of two sets of windings on a small induction motor driving it in a certain direction; the alternator to be paralleled with the first is connected to the other set of windings so as to drive it in the opposite direction; when the voltage, frequency and other factors are alike, this motor should stop and any rotation should show by its direction which is the faster of the two alternators. To adapt this to single-phase machines necessitates a phase- splitting device; for this he suggests a transformer in one of the two circuits.—Lucas. Lond. *Elec. Rev.*, March 24.

REFERENCES.

Municipal Electric Supply.—An editorial discussing some reports to the House of Commons concerning various undertakings by municipalities in England.—Lond. *Elec.*, March 24.

High Wycombe.—A brief illustrated description of this small plant, in which the direct current at 460 volts is used with accumulators and a balancer.—Lond. *Elec. Rev.*, March 24.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Insulation Tables.—The beginning of a reprint of some large tables from Mr. Pigg's recent Institution paper. They are accompanied by no explanation; they give in tabulated form the various rules used in England, and are classified in a convenient way for comparison.—Pigg. Lond. *Elec. Rev.*, March 24.

ELECTRO-PHYSICS AND MAGNETISM.

Solution of Metals by the Arc.—Mr. Bredig, before a society in Germany, recently described his experiments with the production of fine powders of metals, obtained from a cathode when an arc is formed between two electrodes of that metal under water; extremely finely divided particles are thus obtained. Thirty to 40 volts and 6 to 10 amperes are required when gold wires are used, the solution containing a trace of potash. The subdivision is said to be so fine that the dimensions of the particles are smaller than the wave lengths of light.—*L'Eclairage Elec.*, March 18.

ELECTRO-CHEMISTRY AND BATTERIES.

Recent Progress in Electrometallurgy.—In a short article by Mr. Andreoli in the *Elektrochem. Zeit.*, March 1, he mentions recent developments in some directions, particularly in the processes concerning gold. Very brief descriptions are given in some cases Much of that which he mentions has already been covered in previously cited articles, but some of his opinions may be of interest. He claims that in the extraction of lead electrolytically, very great difficulties are encountered; he seems to consider the Tommasi process the best. He states that Vautin, who endeavored to obtain chlorine and alkalies from the fused salt, has abandoned his process; Andreoli believes, however, that it does not necessarily follow that such a method in which fused salts are used, will never lead to favorable results. The gold processes are in general not well adapted for large masses of ore; there is not one among all of them which will work economically with a daily output of 100 to 200 tons of raw material. A brief description of the Cassel process is given; the gold is extracted by a solution of soda containing bromine, and is then precipitated as a sulphide. The Heycraft process is claimed to be a very simple one and requires only two hours; the gold is extracted in a solution of common salt at the boiling temperature, with mercury stirred into it. The Keith process has the great objection that porous vessels are required. The most important points in the electrolytic processes (presumably referring to gold) are, in his opinion, a very definite current density at the anode and cathode, and the necessary time for the action of the current; the liquid should contain no solid substances, but it should be clear. In conclusion he seems to intimate or prophecy that the electrolytic methods of the future will be quite different from the present ones. There is no reason why the continuous current should be used exclusively for electrochemical purposes. He intimates that it would be quite possible that in place of the usual systems a new one using the alternating current at a high tension, may be developed.—Andreoli. *Elektrochem. Zeit.*, March.

Carbon Consuming Battery.—A brief illustrated description of the Dobell battery is given in *L'Eclairage Elec.*, March 18. The retaining cell is of iron, forming the negative electrode, and is filled with fused nitrate of potash or soda or a mixture of both; inside is a porous cup containing fused lead into which dips the carbon plate which forms the positive electrode, and is claimed to be consumed. In the fused electrolyte there is a tube through which a current of air or oxygen is passed so as to percolate through the fused electrolyte. The cell is placed in a furnace to keep the ingredients melted. During the action the carbon is said to be oxidized into carbonic acid gas which passes off. In another form the position of the electrodes is reversed, the porous cup, containing an oxidizing mixture formed of 70 parts of potassium chromate, 12 of chromic acid and 18 of caustic soda, the tube leading the oxygen into it forming the negative electrode. The carbon is introduced in small fragments into the lead contained in the outer iron cup. The porous cup is made of magnesia.—*L'Eclairage Elec.*, March 18.

REFERENCES.

Chloride of Calcium.—An abstract of the recent article by Oettel (see Digest, March 3 and last week).—*L'Eclairage Elec.*, March 18.

Alkali and Chlorides.—Long illustrated extracts from Hargreaves' English patent.—*Zeit. fuer Elektrochemie*, March 23.

Production of Perchlorates.—A very brief description of the Winteler electrolytic process.—*Elektrochem. Zeit.*, March.

Subchlorates of Soda.—A very brief description of the Tailfer industrial process.—*Elektrochem. Zeit.*, March.

Hydrolytic Dissociation and Thermochemistry.—A short supplementary article to his previous one.—Platner. *Elektrochem. Zeit.*, March.

Electrodeposition of Tin.—The continuation of the serial. He discusses the question of recovering tin from tin scrap giving very brief descriptions of some of the proposed processes. Andreoli. *L'Elec.*, March 25.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Wehnelt Interrupter.—Several further notes on this interrupter are given in the various journals. Mr. Hill, in the Lond. *Elec.* and *Elec. Rev.*, March 24, states that self-induction is required to make the break; the counter-current induced in the coil acts after the break and for a moment converts the positive into a negative pole, setting free some hydrogen. He collected the gas given off from the positive pole and by applying a light, found it exploded, leaving, however, considerable quantity of oxygen and ozone.

Mr. Viles,, in Lond. *Elec. Rev.*, March 24, suggests substituting for the lead plate a large globule of mercury, for the dilute acid, distilled water, and for the platinum, an aluminum wire brought sufficiently close to the mercury to cause a small arc under water. This interrupter will work with a low voltage and small current; the mercury must not be too clean and the anode must be aluminum. When working properly it gives out a loud musical note.

Mr. Coates in the same journal calls attention to the fact that an electrolytic method of operating primary circuits of induction coils was described by Sprague in 1884 in the second edition of his book on electricity, page 537. Sprague stated that mercury can be made to break the circuit if a platinum wire serving as the positive conductor, just touches it, and if the mercury is covered with water containing a little acid. An action occurs similar to that which operates the Lippmann electrometer. A film of gas forms, the mercury leaves the point and returns again immediately to repeat the process.

A paper by Mr. Villard before the French Physical Society is briefly abstracted in *L'Eclairage Elec.*, March 25. He states that small coils for 6-cm sparks can be made to give 14 to 15-cm, while for large coils the sparking distance does not exceed 20-cm. The frequency attained being as high as 14,000 to 15,000 per second, the primary current does not have time to reach its maximum value, and therefore the induction is not so great; this is in accord with what was observed with large coils.—*L'Eclairage Elec.*, March 25.

Interrupters for Induction Coils.—Mr. Dessauer, in the *Elek. Zeit.*, March 23 describes at considerable length some improvements which he has made. He believes the motor interrupter to be the best of all of the interrupters, by which he means a mercury interrupter operated by a motor. He arranges the motor so as to operate two cranks at 180° to which the contact points are attached, thus doubling the number of breaks; each of these dips into a separate jar of mercury, but the latter are connected by a tube at a level of the mecury so as to facilitate adjustment; frequencies up to 1500 to 3000 per second are said to be produced in this way. He also describes a modification of the hammer interrupter which consists in making it close a contact at each end of its vibration so as to double the frequency.—Dessauer. *Elek. Zeit.*, March 25.

Pyrometers and Thermocouples.—An abstract of a recent paper by Dr. Bruger, published in the *Elek. Zeit.*, March 16, describes the experiences of the firm Hartman & Braun with electric pyrometers. The description contains a reference to a new thermocouple of platinum and an alloy of platinum with 10 per cent. of nickel. Under the same circumstances it gives about double the voltage of the usual platinum, platinum-rhodium couple. Moreover, the position of the maximum and zero values of the e. m. f. are very favorable for high temperature measurements and the scale is nearly uniform. The couple remains constant up to temperatures of about 1000° C. These couples are protected from the action of the hot gases and mechanical interferences by a refractory material.—Bruger. *Elek. Zeit.*, March 16.

Mechanical Equivalent of Heat.—Mr. Guillaume in *L'Ind. Elec.*, March 10, discusses the various determinations of this equivalent, both by the electrical and the mechanical methods, and concludes that it may be assumed that the mechanical equivalent of a calorie at 15° is equal to 4.190 joules to within about one in one thousand. —Guillaume. *L'Ind. Elec.*, March 10.

REFERENCES.

New Wheatstone Bridge.—A description, without illustrations, of a new form devised by Callendar and Griffiths apparently with special regard to temperature measurements. Some of the modifications are said to be of considerable value. The resistance coils are made of bare platinum silver wire wound on open mica frames placed in a tank of paraffin oil.—Lond. *Elec. Rev.*, March 17.

The Kelvin-Varley Bridge.—A long illustrated abstract of his recent discussion of these modifications of the Wheatstone bridge.—Tobler. *L'Eclairage Elec.*, March 18.

Recording Voltmeter.—A reprint of the illustrated description of the Elliott instrument recently noticed in the Digest.—*Sc. Am. Sup.*, April 8.

Telegraphy, Telephony and Signals.

Telephone Repeater.—In a communication by Mr. Asher, in the Lond. *Elec. Rev.*, March 24, he suggests as a new repeater, the motograph which Edison invented more than twenty years ago. In this the electric current merely controls the vibrations of the diaphragm, the sound being produced dynamically by the motor which turns the cylinder. With the aid of this a message could be repeated with undiminished force into a second circuit, and again into a third and so on; the reproduction of the original voice even at the opposite side of the continent would be louder than the voice itself.—Asher. Lond. *Elec. Rev.*, March 24.

REFERENCES.

Charging for Telephone Service.—An editorial discussion of the proposed new system of charging in Germany.—*Elek. Zeit.*, March 23.

Miscellaneous.

Electric Heating Appliances.—Several forms of some appliances made in England, are illustrated in Lond. *Lightning*, March 23. One of the features of interest in the soldering irons is that they are arranged so that the copper tips can be easily taken off and reforged. A novelty of interest in connection with flat irons is a stand for two irons into which the iron is placed to be heated, the insertion of the iron making contact so that the current passes through the heating device in the iron; no current passes through the iron while in use, thus avoiding the use of flexible cords but involving the use of two irons. Another device is a heater for curling irons arranged for traveling purposes.—Lond. *Lightning*, March 23.

Clarifying Turbid Liquids Electrically.—A preliminary description of a process by Spring is briefly described in the *Elektrochem. Zeit.*, March. He found that water which contains fine suspended particles of non-electrolytes, will become clarified if subjected to the action of an electric current, in the same way as it is clarified by the addition of salts, an acid, or by means of heat. The current need only be quite small, but should have a sufficiently high voltage. In explaining the phenomena he assumes that the suspended particles are in a certain electrical condition which prevents them from uniting and then settling. When the current is passed this electric condition is changed and the particles unite and then fall to the bottom. No further description is given.—*Elektrochem. Zeit.*, March.

New Books.

ELECTRICITY IN TOWN AND COUNTRY HOUSES. By Percy E. Scrutton, Second Edition. New York: The Macmillan Company; 148 pages, illustrated. Price, $1.00.

The author states that the object of this little book is to put before the reader in popular form, without technical details, the many uses to which electricity can be put in his house. What the book really consists of is a collection of cuts, mostly bad except those evidently from trade publications, and five chapters of text, of which two are on central stations and isolated plants, a third on "the advantage of electricity compared with other forms of energy," and a fourth on the cost of electricity. As an example of the appropriateness of the engravings, the two illustrating the remarks of the text on water power generation show, one a mountain, and the other the exterior of a turbine and dynamo house. Another cut has the caption "steam engine and boiler," and shows nothing electrical, while a view of a gasometer serves to illustrate a remark concerning gas engine electrical generation. The unfavorable impression created by the cuts and chapter headings is somewhat lessened, however, upon reading the text, which gives a fairly good and connected popular account of the generation, distribution and household uses of electricity.

The Worcester Polytechnic Institute, Worcester Mass., has issued its twenty-ninth annual catalogue (1899).

Electric Wiring Practice. The paper read by Mr. Frederick Bathurst before the Incorporated Association of Municipal and County Engineers, England, has been published in pamphlet form. The paper deals with the present practice and probable development of the art of electric wiring, and is written entirely from an English standpoint. Some reference is made to the wiring practice in the United States.

Berly's Universal Electrical Directory for 1899 contains the names of the members of the electrical and kindred industries throughout the world. It is divided into four sections, British, Continental, American and Colonial, and contains a total of 25,464 distinct names, about 1670 more than last year's directory. In addition to the names, which are arranged alphabetically and by classification, much financial information is given. This directory is published every year by Messrs. H. Alabaster, Gatehouse & Co., London.

BOOKS RECEIVED.

Small Accumulators. How Made and Used. By Percival Marshallä. An Elementary Handbook for the Use of Amateurs and Students. New York: Spon & Chamberlain. 80 pages, 40 illus. Price, 50 cents.

HANDBRUCH DER TELEPHONIE. Nach dem Manuscript der Dr. Victor Wietlishbach. Bearbeitet von Dr. Robert Weber. Wien: A. Hartleben's Verlag. 368 pages, 372 illus. Price, 10 marks.

THE ARITHMETIC OF CHEMISTRY. A Simple Treatment of the Subject of Chemical Calculations. By John Waddell, B. Sc. (Lond.), Ph. D. (Heidelberg), D. Sc. (Edinburgh), formerly assistant to the professor of chemistry in Edinburgh University. New York: The Macmillan Company. 133 pages. Price, 90 cents.

Electric Rainbow Fountain.

Among the many elaborate decorations at the recent bachelor dinner given by Mr. W. K. Vanderbilt, Jr., at Sherry's in New York, the "Electric Rainbow Fountain" proved to be the centre of attraction. The fountain in question, which is an American modification of a handsome foreign design, is shown in the accompanying illustration.

The pyramidal form of the water is produced by forcing it through a perforated glass globe, and the various color effects are obtained by revolving a multi-colored disc beneath the jet. Rays of an electric light from an ordinary 32-candle-power incandescent lamp re projected through the globe upon the spray, which sparkles like myriads of gems. In one form manufactured, the use of a small electric pump renders the fountain entirely self-contained, and admits of the use of the same water continuously, no connection with the water system being required.

THE RAINBOW ELECTRIC FOUNTAIN.

The parts of the fountain consist of a cast iron basin in the centre of which is secured the hemispherical globe of clear glass. The water enters between this globe, and a flat glass plate, beneath which is the colored disc rotated by a small overshot water wheel, motion being imparted by the overflowing liquid.

The Electric Rainbow Fountain is patented in the United States and Europe, the American rights being controlled by Mr. Robert Graves, of 483 Fifth Avenue, New York.

Development of the Insull Manufacturing Interests.

For some weeks past there has been considerable curiosity in electrical circules as to the alleged return of Mr. Samuel Insull, president of the Chicago Edison Company, to the field of electrical manufacturing. It was known in well informed circles that he had lately taken control of certain important properties of that character, but there have also been persistent rumors that Mr. Insull was to be president of the consolidated electric light concerns, under the Whitney regime in New York City.

The relations of the manufacturing and consumption sides of the industry are such as to give extreme interest to any move made at this juncture and to give warrant to almost any reports on the subject. Mr. Insull was a visitor to New York last week and for the first time consented to make known his plans. They are of far larger scope and aim than had been imagined, as will be seen. It must be noted at the outset, however, that Mr. Insull stated positively his intention to remain in Chicago at the head of the Edison Company there, and that he dismissed as an idle compliment the rumors of his taking charge of the central station work in New York City. He also renewed his denial of the report of any present negotiations for sale of the Chicago Edison to Chicago Gas interests.

In response to inquiries on the manufacturing subject, Mr. Insull said: "I have bought the greater portion of Mr. Sigmund Bergmann's interest in the General Incandescent Arc Light Company, in which hitherto I had only a minority interest. I have also acquired the whole of the capital sock of the New York Electrical Equipment Company, which will virtually be owned by the General Incandescent Arc Light Company and operated under the same management, doing a construction business as heretofore, but reaching out now in its operations as far West, at least, as Buffalo and Pittsburg. The General Incandescent Arc Light Company will go on manufacturing the same line of goods it has made heretofore, which, as you know, involves no interference with the work of the larger manufacturers. There is an immense domain of smaller specialties to be filled up and I have always tried to develop it. We shall make the smaller sizes of dynamos and motors, but particularly the minor articles of all kinds needed by illuminating companies and their customers."

The officers of the General Incandescent Arc Light Company are: Mr. Samuel Insull, president; Mr. S. Bergmann, first vice-president; Mr. Martin J. Insull, second vice-president, and Mr. P. H. Klein, secretary and treasurer, all well known. As to other lines under his control or that of his concern, Mr. Insull stated that the Paragon motor interests had been bought and would be pushed in both the fan and small power fields. The Wright discount meter is owned by him also and is in great demand, the manufacturing being done in the General Incandescent Arc Light Company's factory in this city on First Avenue.

A "G. I." incandescent lamp has also just been put on the market, but Mr. Insull is reticent as to details of its production, although it is not an unreasonable assumption that owing to his connection with the Fort Wayne Lamp Company and the adjustments due to the death of Mr. McDonald, he may have secured all the necessary facilities in this direction for a very large output.

So far, much of the above news had already been known, even if not all public property, but Mr. Insull's real surprise came last week. "Associated with Mr. F. Nicholls, of the Canadian General Electric Company and some of his influential Toronto friends I have," he said, "taken hold of the Fischer Equipment Company, of Chicago, which makes the Woods electric carriages that have attracted such favorable attention in the electrical press, and I have become president of the concern, Mr. Nicholls being vice-president. Provision will be made for manufacture on both sides of the lakes, and I need hardly say that we expect a very large output. Our inquiries are simply enormous. As one immediate result, the first probably, of many such steps, the Chicago Electric Vehicle Company has been formed with a subscribed capital of $2,000,000, the incorporators being Mr. E. L. Brewster, the banker, Mr. W. G. Beale, former corporation counsel of Chicago, and myself. The swift success of the cabs in New York is sufficient guarantee of what we can do in level Chicago with all the improvements we shall introduce."

Asked what the means would be for equipping such vehicles, for which Mr. Insull intimated there was waiting a splendid field in Chicago, he called attention to the tests made of the Willard battery by Messrs. L. A. Ferguson, chief engineer of the Chicago Edison Company, and C. L. Edgar, vice-president of the Boston Edison Company. The batteries have been in service in Cleveland and Wilmington and the results found by these experts were very satisfactory. The Willard battery is now made by Sipe & Sigler in Cleveland, and plans are in view for putting its production on a

much larger basis. Inferences are obvious, but it is curious that things should have taken this shape at a time when other large operating interests had also sought to protect their supply of batteries by obtaining control of their manufacture. There has been a great deal of gossip among central station people on this point, as they have feared, being faced by a famine as to batteries just at the moment when their requirements were becoming greater than ever before in the history of the art.

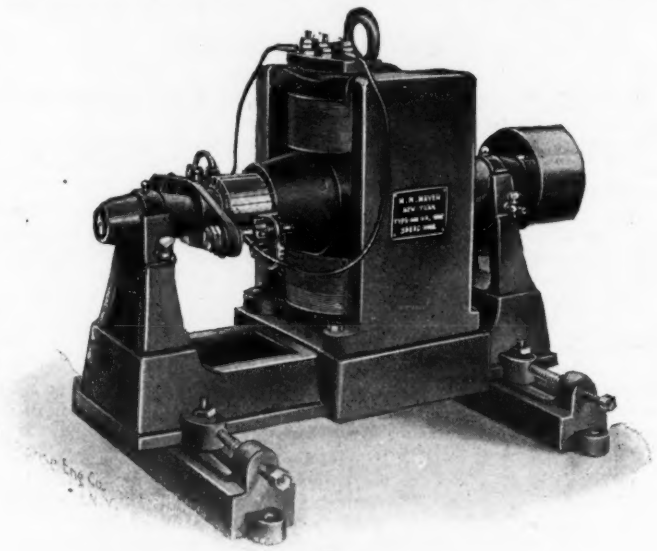
When asked as to plans for marketing his goods, Mr. Insull said that he proposed to work along the lines that he had inaugurated when building up the Edison General Electric Company, and which had since been followed closely by the larger organization. The General Incandescent Arc Light Company would control its own distributing agencies as far as possible, and one of the moves in the West in that direction was the organization of the Martin J. Insull Company, taking over a large business already running in Chicago. There would be salaried representatives in Minneapolis and St. Paul, Milwaukee, St. Louis and other large cities. Influential affiliations were offered everywhere.

In New York there was the parent company and its familiar downtown distributing agency in Cortlandt Street. Mr. J. B. Cowan, who has been in the service of the Chicago Edison Company for some few years past, and who once was traveling representative for one of the big Scotch thread houses, has been appointed manager of the export department with headquarters at the New York sales office, of which he will have charge. Mr. Insull further stated that in the immediate future, agencies would be opened in the larger Eastern cities, and admitted that there was some truth in the rumor that he has an intention of opening a London branch.

The Mayer Dynamos and Motors.

The machine shown in the accompanying illustration is of the two-pole ironclad type, the magnetic frame being cast in one piece of open hearth steel, and bolted to a substantial iron base, which also has the supports for pillow blocks cast with it. These supports are bored out at the same time as the pole pieces, thus securing the best alignment. The field coils are separately wound on well-insulated metal spools, which are slipped over and secured on the magnet cores.

The armatures are of the slotted-drum type, finely laminated to



MAYER MOTOR AND DYNAMO.

avoid heating. They are insulated with mica throughout, and the winding is such as to secure the best electrical and mechanical balance. The carrying capacity of the conductors is large, so that machines can stand considerable overload without injury. The commutators are tempered copper, insulated with sheet mica, and have large contact and wearing surfaces. Carbon brushes are used in self-feeding brush holders, and the tension on the brushes can be changed at will. The mechanical construction is of the highest standard of excellence. The shafts run in self-oiling phosphor bronze bearings.

These machines are built in four sizes at present, namely, 1, 2, 3 and 5-hp. Every machine is provided with iron slide rails and underload automatic starting box for motors and field rheostats for dynamos. The machines described are manufactured by The Maxwell M. Mayer Electric Company, Second Avenue and 121st Street, New York.

Igniter for Welsbach Lights in Series.

The difficulty of igniting Welsbach burners located in elevated fixtures limited their use until the old form of electric gas lighting apparatus was modified so as to be applicable. In lighting a number of these lamps in series, by coil or frictional machine, the peculiar enclosed form of the light, the chimney and the delicate mantle, presented conditions of considerable difficulty in the attachment of the spark electrodes, as not only had ample insulation to be provided in a narrow and contracted space in the lamp parts, but, at the same time, the mantle must not be endangered.

FIG. 1.

The A. L. Bogart Company, 123 Liberty street, New York, has lately put on the market a simple and convenient device for series spark lighting (Fig. 1), which is particularly adapted for use with Welsbachs and mica chimneys. The two electrodes are rigidly attached to the porcelain holder, provided with a slot in its base, which embraces the top of the mica chimney, as shown. Fig. 2 shows the electrode holder or clip on an enlarged scale. A porcelain pillar is also supplied, which insulates the metal work of the entire lamp. With this device no alteration or cutting of the lamp is necessary. The electrode spark-points are below the level of the top of the chimney, so that draughts of air cannot divert the stream of gas from the spark.

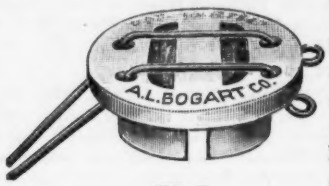
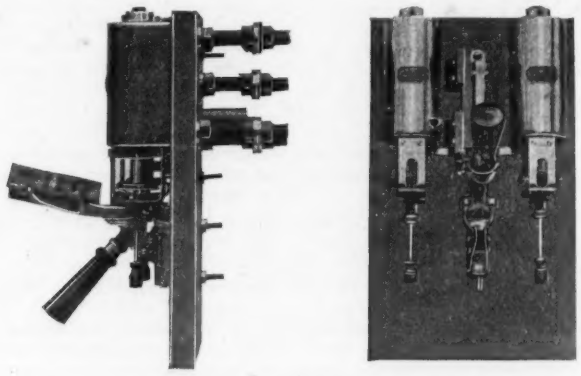


FIG. 2.

New Ward Leonard Circuit Breaker.

We illustrate herewith a Ward Leonard circuit breaker of special type, designed for use in connection with storage batteries and similar equipments in which the circuit breaker must open the circuit not only upon overload current, but also in case the voltage



SIDE AND FRONT VIEW OF CIRCUIT BREAKER.

exceeds a certain predetermined amount. By slight modifications in this construction, circuit breakers are made by the Ward Leonard Electric Company, which will open the circuit automatically on predetermined overload current and predetermined high voltage; or predetermined overload current and predetermined low voltage; or upon predetermined high voltage and low voltage, or upon predetermined underload current and predetermined overload current, or, in fact, any desired combinations of different conditions upon which it may be desired to open the circuit automatically.

NEWS OF THE WEEK.

Financial Intelligence.

BOSTON ELECTRIC LIGHT COMPANY has declared its regular quarterly dividend of $1.50 per share.

UNION TRACTION of Philadelphia has cut its ratio of operating expenses down to 41 per cent. It was as high as 64 three years ago.

NEW ENGLAND TELEPHONE DIVIDEND.—At a meeting of the directors of the New England Telephone and Telegraph Company, held March 22, a dividend of one dollar and fifty cents per share was declared, payable May 15, 1899.

ELECTRIC LIGHT BONDS in the larger cities are becoming more and more in favor all the time. Chicago Edison 12-year 5s sold last week at 110, or a 4 per cent. basis, and the Commonwealth company of Chicago, whose 5 per cent. bonds were placed on the market a few months ago, are now commanding a substantial premium.

INDUSTRIAL CAPITAL.—The *Financial Chronicle*, after excluding from its lists all corporations that are not the combination of two or more concerns, figures out that since Jan. 1, the capitalization of new "combines" reaches $1,526,325,000, with $60,000,000 increase of capitalization in the tobacco companies. This is at the rate of over $500,000,000 a month or $6,000,000,000 a year.

POSSIBILITIES OF ELECTRICAL MANUFACTURE.—In a financial despatch from Boston, note is made of some striking figures as follows: "The General Electric is doing a business of $18,000,000 per annum and the Westinghouse-Walker Companies, a present business of nearly $12,000,000 per annum; a combined electric business of nearly $30,000,000 per annum, which at the prices prevailing when the Edison and Thomson-Houston were consolidated into the General Electric would make a business of considerable more than $100,000,000 per annum." But those old prices may never come back.

CENTRAL UNION TELEPHONE MORTGAGE.—A mortgage has been filed in the Jefferson County recorder's office, Illinois, from the Central Union Telephone Company, of Chicago, in favor of the Old Colony Trust Company, of Boston, in the sum of $6,000,000, payable in gold, with interest at the rate of 5 per cent., payable annually. The debt is divided into 6000 mortgage bonds of $1000 each, date of Jan. 2, 1899, due Jan. 2, 1919, with optional payment after Jan. 2, 1909. These bonds are secured by a deed of trust on the company's franchises and properties, personal and real, owned and controlled throughout the states of Illinois, Indiana and Ohio.

SPEAKING OF COPPER, Mr. Leonard Lewisohn, of Lewisohn Bros., the leading metal dealers of the world, says: "We and everybody else are powerless to stop the advance in copper. We have sold more copper the last week than in the six weeks preceding, and while we may regret a copper market at 20 cents or above, we must face the situation as it is. The electric companies in America are using 40 per cent. more copper than a year ago, and the foreign demand continues. I do not see where the supplies are to come from. The only mine that can increase supplies to any extent this year is the Utah, which will soon begin production on a considerable scale, but from no other district can the supplies this year be materially increased over last year."

ELECTRICITY SPELLS DIVIDENDS.—The first dividend ever declared on any Chicago Elevated Railway stock was made lately, as noted, when the directors of the South Side "L" decided on placing their company's stock on a 3 per cent. basis by a disbursement of 1 per cent. every four months, and not ¾ per cent. every three, as had been rather expected. The dividend is payable May 1. Transfer books close April 20. This satisfactory result is more than a good deal due to the changing of the motive power from steam to electricity. It made increased traffic, people generally being far less afraid of accident with electric power than when steam was used. Traffic is now the heaviest in the history of the company, averaging close on 63,000 daily. The total stock issue of the company is $10,323,800, and the dividend declared will require $103,238. The company during the last year has earned 3½ per cent. on its capital stock.

LONG ISLAND RAILROAD.—Electrical equipment of the whole Long Island Railroad system is contemplated, in time. The directors recommend it, and the stockholders are requested to approve the plan on April 11, when a meeting to consider the plan will be held. President W. H. Baldwin, Jr., of the Long Island Company last week gave out a statement relative to the scheme to be proposed to the stockholders of the road. He recommends a new mortgage of $45,000,000 at 4 per cent. Of this sum, $28,000,000 is reserved to retire, or rather to refund, existing indebtedness; to acquire leased and controlled lines, and to liquidate the indebtedness thereon. Provision is made to pay for improvements, including those in Atlantic avenue, and for electrical equipment. Eight millions of the bonds are set aside to pay the costs in case a change to electricity or other motive power should be deemed advisable. The remaining $4,000,000, together with any bonds not used for the Atlantic avenue improvement and the abolition of grade crossings, may be issued only for permanent betterments.

NEW ENGLAND ELECTRIC VEHICLE COMPANY has already been noted in this department. Among its officers are Mr. C. L. Edgar, of the Boston Edison Company, and Mr. F. A. Gilbert, of the Boston Electric Light Company. It has also some of the most solid financial interests in New England back of it, such as Lee, Higginson & Co., and the Old Colony Trust Company. The capital stock is $25,000,000 and of this the $15,000,000 offered for subscription privately was taken up at once. Mr. Edgar was in New York last week and stated that the outlook was excellent. Not only could they place in Boston every vehicle obtainable, but they intended to put in service at Newport this summer a regular service, for which there was already a demand beyond the capacity. Boston with 100 vehicles would need 1000, and Newport could more than keep busy its 100, if it could get them all. Mr. Edgar has long been an ardent advocate of the growing field of the storage battery and has backed his convictions by his actions. The Boston Edison storage plant has found many imitators, and Mr. Edgar meantime has moved forward into the newer fields of electric navigation and electric vehicles.

THE WEEK IN WALL STREET was characterized chiefly by a decided slump in industrials. These securities, many of which are of great intrinsic value, have of late been created in such quantity that the capacity of the market to absorb them appears to have been exceeded, while the banks have been very chary of recognizing them as collateral. Under these circumstances, the market experienced a sharp decline, although electrical industrials came off by far the best in the whole crowd. During the week, on sales of 22,223 shares, Western Union went off slowly to about 93⅝. General Electric declined to 115 on sales of 5775 shares. Metropolitan Street Railway Company had a bad tumble to 249 on sales of 48,720 shares. In Boston, American Bell Telephone experienced a decline of 13 points from 368, but West End Railroad was steady and even advanced to 94½. Among "outside" securities, in New York, Electric Vehicle pref., was steady at 135 bid and 145 asked, common 138 and 142. Electric Boat was quoted at 34. General Electric Automobile was quoted at 33 to 35. Hudson River Telephone was 89 to 92. New York Electric Transportation 20 to 21. Otis Elevator pref., 89 to 90, and common 34⅞ to 36.

GENERAL CONDITIONS.—In discussing the business outlook, Bradstreets says: "The situation as regards prices is still a very favorable one, the list of staples advancing or remaining steady being by far the most numerous, while bank clearings statistics, railroad earnings and all other obtainable measures of trade progress point to an immense business, speculative and otherwise, having been done during the first quarter of the year 1899. Immense speculative activity, heavy financial operations consequent upon the formation of industrial combinations and the undeniably large volume of trade moving are reflected in bank clearings for the month of March and for the first quarter, which are in advance of all records. The total clearings at 79 cities for the month just closed aggregate $8,704,671,860, 25 per cent. larger than those of February, 3 per cent. larger than the hitherto unprecedented total of January and 55 per cent. larger than those of March one year ago, while twice to two and a half times as large as the corresponding totals of 1897 and 1894. Gains are heaviest in the group of middle states cities, headed by New York, but heavy increases are noted in the Southern, New England and Northwestern groups, the smallest gains being reported in the Southwest and on the Pacific coast. For the first quarter of 1899 clearings aggregate $24,138,968,796, an increase of 40 per cent. over last year, of 95 per cent. over 1897, and 119 per cent. over 1894, and of 50 per cent. over 1892."

Special Correspondence.

NEW YORK NOTES.

MR. C. T. YERKES is said to be likely to move to New York as soon as he has sold out his interests in Chicago street railways.

SEARCHLIGHT ON A FIREBOAT.—An electric searchlight has been placed on the fireboat "New Yorker." It is of 1000-cp and was tested a few nights ago, with satisfactory results.

THE HAAN RESTAURANT in the new Syndicate Building, on Park Row, will be the largest in New York City, covering a floor space of 6400 square feet. It will be able to feed 5000 persons a day, and all the cooking is to be done by electricity. It will be carried on by Mr. R. M. Haan.

TO SEE THE CUCKOO.—A committee composed of Messrs. H. W. Baker, J. H. Dale, F. W. Harrington, J. T. McKeever, E. S. Keefer and H. B. Kirkland are arranging another theatre and supper party on the lines of last year. It is to take place on April 25. The piece to be seen is the "Cuckoo," at Wallack's, followed by supper at the Waldorf. The cost is $18 for two participants. This includes flowers, electric cabs, cigars, souvenir, etc. Subscriptions should be sent to Mr. John H. Dale, at 22 Thames Street.

NEW YORK LIGHTING PLANTS.—Rumors have been afloat the past week as to a deal on foot for the acquisition of the United Electric Light & Power Company, owned by Westinghouse interests, by the Manhattan and Third Avenue Railways. The company has a fine plant at East Twenty-ninth Street and East River, and has a capital stock of $5,000,000 and bonds of $5,000,000. Its circuits encompass the whole city and it has exclusive franchises for multiphase work, so that it is in a position of great advantage. None of the rumors have been positively confirmed.

PHILADELPHIA NOTES.

MR. JAMES H. YEARSLEY, 44 N. Fourth Street, Philadelphia, has recently patented a very novel and effective brush holder. This device, he claims, will equalize the pressure over the entire surface of the commutator, thus reducing the liability to sparking to a minimum.

THE GENERAL ELECTRIC AUTOMOBILE COMPANY, Philadelphia, has recently placed a large order for machinery with the S. A. Woods Machine Company, of Boston, through its Philadelphia agent, J. W. Cregar. This company expects to have its new factory fully equipped and in shape to fill orders within a very short time.

Western New York Notes.

NEW GRAPHITE PLANT AT NIAGARA FALLS.—Ground has been broken on the lands of the Niagara Falls Power Company at Niagara Falls for the new Acheson Graphite Company's plant.

THE INTERNATIONAL TRACTION COMPANY has reorganized the Niagara Falls & Suspension Bridge Railway; the Niagara Falls Whirlpool & Northern Railway, the Buffalo & Lockport Railway and the Buffalo & Niagara Falls Railway.

AN ELECTRIC RAILWAY ON GRAND ISLAND.—Edgar B. Jewett, James E. Curtiss, Ernest Wende, N. W. Norton and John L. Nice propose to build a trolley line on Grand Island in the Niagara River. The consents of property owners have been filed.

SELECTING THE SITE FOR THE PAN-AMERICAN EXPOSITION.—Messrs. D. H. Burnham, of Chicago, Ill., and Frederick Law Olmstead, of Brookline, are the two experts who will select the site for the Pan-American Exposition to be held on the Niagara frontier. Sixteen sites are under consideration.

NEW CARBIDE WORKS IN CANADA.—Ground will be broken for a new carbide works in Canada as soon as the Willson Carbide Company of St. Catharines, Ont., find a suitable site on which to build. The Merritton, Ont., plant will not be closed, but will be continued in operation. Its capacity, as at present operated, is insufficient to supply the demand, which is constantly growing.

FREE LIGHT AND POWER FOR THE NIAGARA RESERVATION.—The commissioners of the New York state reservation at Niagara at a recent meeting decided to notify the Niagara Falls Power Company that they stood ready to accept free water, light and power from the company in accordance with the provisions of a bill passed by the legislature in 1892. A formal notice was drawn up by the attorney general of the state to serve on the company.

GASOLINE CARRIAGES IN A BUFFALO PARK.—The Buffalo (N. Y.) Park Board has voted to enter into a contract with the National Motor Transit Company permitting that company to run gasoline carriages in Delaware Park, beginning Aug. 1. The board reserves the right to terminate the contract at will. The fare is to be five cents. Had electric carriages been adopted the fare was to be ten cents. Experts were of the opinion that electric carriages could not be run in the park.

A NEW INDUSTRY AT NIAGARA FALLS.—The Co-operative Silver Company has been organized at Niagara Falls and will use electrical power from the Niagara Falls Hydraulic Power & Manufacturing Company for the operation of its factory, which is to be located on Main street, that city. The capital of the company is $30,000. The directors are John Bruns, Charles H. Fessenden and William N. Fessenden. William N. Fessenden is president and Charles H. Fessenden is secretary-treasurer of the company.

ELECTRIC VEHICLES AT NIAGARA FALLS.—The commissioners of the state reservation at Niagara have granted Mr. John C. Level, proprietor of the Reservation Van Service Company, the right to substitute electrically operated vehicles for the present vans as soon as the electric carriages have been so far perfected as to assure a reliable service on the various grades of the state property. It is believed that the greatest grade to be encountered is about eight per cent. In any event, the wish is to have electric carriages on the reservation by Pan-American year, 1901.

Indiana Notes.

KOKOMO, IND.—An extension of the electric street railway lines is meeting with strenuous remonstrances from a number of leading citizens, who object to the lines being placed in front of their property, notwithstanding the promises of the company to give the best of service.

THE CENTRAL UNION TELEPHONE COMPANY, at Indianapolis, has extended its rates for the "mile radius" district to all subscribers within three miles of the central station. Patrons living more than one mile and less than three miles from the exchange were surprised this month to note reductions in their quarterly bills, amounting from 10 to 15 per cent., according to the kind of service. There are indications of a further reduction to meet the competition of the new company.

THIRTY-FOUR YEAR FRANCHISE IN INDIANAPOLIS.—A contract for a thirty-four-year franchise for the Indianapolis Street Railway Company was signed on April 6. Under the contract the company is to pay the city $1,160,000, in cash, in installments. The cash fare is to be 5 cents; six tickets for 25 cents, and twenty-five tickets for $1, all with transfer privileges. The company also binds itself to bear the cost of paving between the tracks and for eighteen inches on either side.

PETITION FOR A RECEIVER.—The Metropolitan Trust Company, of New York, has brought suit in the United States Circuit Court at Indianapolis against the Lake Cities Electric Railway Company, which was organized to build and operate an electric railway from Michigan City to Laporte and on to other lake cities. The petition asks for the foreclosure of a $300,000 mortgage and the appointment of a receiver. The property of the electric company includes franchises for an electric line, and for lighting Michigan City and other privileges.

FRANCHISE DENIED IN INDIANAPOLIS.—The common council of Indianapolis has denied a franchise to Daniel Cheneworth and others for a period of 20 years to locate an electric light plant in the extreme southeastern part of the city for the purpose of furnishing lights for private use. The grounds of refusal are that others would demand similar rights for other remote sections of the city, and when the time came for the city to control its own electric lighting plant great difficulty would result in putting these long time franchises out of the way.

INTERURBAN ELECTRIC LINE.—The Gagerstown (Ind.) council has granted an exclusive franchise to the Cambridge City Interurban Traction Company to build and operate an electric railway within the town limits. The franchise is for 50 years and becomes operative when the railway proposed is completed to within a half mile of the town limits. The company proposes to build 31 miles of road between Cambridge City and Economy. A 500-hp plant will be erected, and the company will furnish light, power and heat to the citizens of towns and the farmers along the route.

TELEPHONE WAR.—There is indication of a lively telephone war at Richmond, Ind., between the independent companies and the Central Union people. The Home Telephone Company is hurrying forward the construction of an exchange and is also arranging for exchanges in the smaller towns of the country. Co-operation has been arranged for between the Home company and the New Long-Distance Company, of Indianapolis, and the Citizens' Telephone Company, of Cambridge City, which reaches a large number of places. The Home company has met with much encouragement and has many patrons.

ELECTRIC VEHICLES.—The Indiana Bicycle Company, of Indianapolis, has completed the first two of a large number of electric vehicles of a new design which the company has orders for. The largest of these was given a trial trip on March 30. This vehicle has been constructed for a Providence, R. I., department store, and on the trial trip ran 54 miles on one charge of the battery, and still had considerable power left in it. Up to this time no electric vehicle had shown, it is claimed by the makers, more than 35 miles on a single charge, while the average has been about 25 miles. The builders claim that the vehicle after being broken in will run 60 to 70 miles. The vehicle easily climbed the steep viaducts of the city and plowed through unimproved streets, where a considerable amount of power was required. The builders are highly gratified, and will turn out the vehicles rapidly from now on.

Wisconsin Notes.

THE JACKSON MILLING COMPANY of Stevens Point will spend $125,000 this summer in building a 13-foot dam across the Wisconsin River and an electric power house.

THE FOX RIVER VALLEY ELECTRIC COMPANY is planning to extend its Neenah-Appleton line to Kaukauna. There is no doubt that the line will be built, and the inference is that it will be commenced, if possible, this spring.

BILL TO REDUCE STREET CAR FARES IN MILWAUKEE.—A bill known as 78s. is before the legislature which, if passed, will authorize the city of Milwaukee to reduce and regulate the rates of fares charged by the Milwaukee Electric Railway & Light Company. The fare is now 5 cents, with transfer privilege, and it is claimed by the company that this is a reasonable rate for the service given. The company is fighting the bill.

St. Louis Notes.

THE KINLOCH TELEPHONE COMPANY has conveyed its property to the Mississippi Valley Trust Company in trust to secure an issue of $1,400,000 worth of bonds.

THE KINLOCH TELEPHONE COMPANY.—It is probable that the Kinloch Telephone Company will ask for a franchise in Belleville, Ill. A representative was there last week explaining the benefits to be derived from an independent system.

THE ST. LOUIS TRACTION BILL.—A street railway franchise bill identical in its provisions with the St. Louis traction bill, which was recently killed by the railroad committee of the house of delegates, is expected to be introduced in the city council shortly. It is said that the reason the promoters of the first bill allowed it to be filed without appearing in its behalf was that they had inadvertently chosen for their enterprise the name of a corporation already in existence under the laws of the state.

ST. LOUIS WORLD'S FAIR ELECTRICAL SUBSCRIPTIONS.—It was announced at a meeting of the representatives of the various electrical firms and agencies which do business in this city that a few dollars over $25,000 had already been raised for the fair. This amount was not final. The electrical association had fixed the sum of $30,000 as the minimum amount of its subscription, when it organized a few days ago. The reports from out of town firms were more encouraging and it is thought that within a week or two the money will be arranged for.

THE SALE OF THE PEOPLE'S RAILWAY.—Final papers for the sale of the People's Railway to the Brown Brothers Syndicate of New York have been drawn up. The signers for the People's Railway bondholders are Messrs. August Gehuer, Charles Parsons and L. M. Rumsey. Patrick Calhoun represents the Eastern purchasers. The road was sold on a basis of $92.50 for each third mortgage bond of the par value of $100. Messrs. Brown Brothers intend to change the motive power of the road to electricity, and equip it with new rolling stock.

THE KINLOCH TELEPHONE COMPANY has filed a deed of trust to the Mississippi Valley Trust Company for $1,400,000. This amount is covered by the telephone company's property and appliances in Illinois and Missouri. The deed was given, it is said, to protect the bondholders. It contained $999.50 worth of revenue stamps, the largest amount placed on a deed filed in St. Louis since the war. It is given out that the deed was filed to secure an authorized issue of $2,000,000 of 30-year 6 per cent first mortgage bonds. The company announces that all of the bonds now issued, $1,400,000, have been sold. It is stated at the telephone company's office that there was no financial embarrassment whatsoever, and the filing of the deed was simply a part of the financial scheme decided on when the company was first organized.

ELECTRICIANS AS STATE OFFICERS.—The Texas legislature has passed a bill requiring that the State Superintendent of Public Buildings and Grounds must be an expert electrician.

LIGHTING PLANT FOR AN INSANE ASYLUM.—The state insane asylum at Austin, Texas, is to be equipped with its own electric lighting plant if the legislature makes an appropriation for the improvement.

THE UNITED PROJECTS SYNDICATE, the English company that recently purchased the tramway system in the city of Vera Cruz, Mexico, has already begun extensive improvements of that property. The system will be equipped with electric motive power and the lines extended. This company has also purchased the Alvarado Railroad in the state of Vera Cruz.

THE MONTEREY & SANTA CATALINA STREET RAILWAY SYSTEM in Monterey, Mexico, has just been sold to S. W. Slayden, a capitalist of Waco, Texas. It is understood that eastern capitalists are associated with Mr. Slayden in the purchase. The former owner of the system was Major Jules Randle, an American who went to Monterey many years ago and built the line. Electric power will be applied to the system as soon as the necessary plant and equipment can be installed.

STREET RAILWAY FOR LEON, MEXICO.—Messrs. T. H. Jeffries and B. L. Kintley, Chicago capitalists, have obtained a concession for the building of a street railway in the city of Leon, state of Guanajuato, Mexico. Leon is one of the largest cities in Mexico. It has many large manufacturing concerns and the new street railway system will connect some of them, forming a belt line around the city and traversing all of the principal streets. It is expected that it will do a large freight business in addition to its passenger traffic.

PROPOSED STREET RAILWAY CONSOLIDATION IN GALVESTON, TEXAS.—A proposition has been made to the city council of Galveston for the consolidation of the City Street Railway and the Gulf Street Railway companies of that city, and asking that a franchise be granted the consolidated company for a period of 25 years over practically every street in Galveston. The proposition was referred to a committee. It is almost certain that should it be granted the state Attorney General would file suits against the companies for forfeiture of their respective charters on the ground that the consolidation is in violation of the anti-trust law.

PACIFIC COAST NOTES.

NEW TELEPHONE LINES IN WASHINGTON.—Bossburg, Wash., has been connected by telephone with Colville, Stevens County.

ELECTRIC PLANT IN A LARGE SAWMILL.—The McCormick Lumber Company has installed an electric lighting plant in its large new sawmill on Rock Creek, near Pe-Ell, Wash.

LIGHT AND POWER COMPANY FOR SANTA ANA.—Santa Ana, a city of 6000 people, is to have a new electric light and power company, in which Los Angeles people will be the leading capitalists.

ELECTRIC CONDUITS.—In Los Angeles the conduit ordinance has been complied with by all the companies save a district messenger company, and the work of tearing down poles is under way.

MESSRS. YERXA BROS. & Co., of St. Paul and Minneapolis, using some 35 wagons in the two cities for the delivery of groceries, are in the field for an electrical equipment of the same character which will enable them to dispense with horses.

THE MUTUAL ELECTRIC LIGHT COMPANY, San Francisco, recently purchased a lot 137 feet square at the north corner of Spear and Folsom Streets, for $15,000. The company will soon need more space for electric power station purposes if it continues to extend its mains at the present rate.

THE COLUMBIA ELECTRICAL & REPAIR COMPANY recently filed articles of incorporation. The incorporators are C. B. Hawthorn, A. Welch and S. T. Harrison; capital stock, $10,000. The principal place of business is Astoria, Ore. The company purposes to deal in all kinds of mechanical and electrical apparatus and machinery and to conduct a machine and repair shop.

SAN FRANCISCO'S ELECTRIC LIGHT BILLS.—The Board of Supervisors has decided to pay the San Francisco Gas & Electric Company's bills for city lighting for one year, on the basis of the two years' contract, which has been declared illegal. The law provides for a contract for but one year at a time. Bids will be received for a new lighting contract on July 1 next.

YUBA POWER FOR SACRAMENTO.—It is reported from Sacramento, Cal., that the Secramento Electric, Gas & Railway Company, which operates the Folsom water power electric plant, has entered into a 30-year contract with the Yuba Electric Power Company, of Marysville, for the exclusive use of 5000-hp. The current is to be transmitted to the Sacramento Company's power and distributing station in Sacramento.

THE MOUNT LOWE RAILROAD, which runs from Pasadena to the summit of Mount Lowe, was sold at receiver's sale on March 29 for $190,000. The road's affairs are in better shape now than ever before, and extensive improvements and a slight extension are in contemplation. Mr. Valentine Peyton is the new president, with headquarters in Los Angeles. The road was built over government land and the titles were cleared up by the last session of Congress. The main line of the road is operated by electricity, with a gap of high grade covered by cable.

TELEPHONE EXTENSIONS IN OREGON.—A telephone line was recently completed in the suburbs of Portland, Ore. It extends from the Base Line Road to the Section Line Road and thence eastward. A number of farmers in that district propose to have telephone connections.——The citizens of Endersby, Ore., will soon have telephone connection with the outside world, via Eight Mile, they having agreed to erect the necessary poles as an inducement to the telephone company.——A large number of subscribers has been obtained for a local telephone system in Hood River, Oregon.

THE SEATTLE-TACOMA ELECTRIC RAILROAD, promoted by Henry Bucey, of Tacoma, Wash., is almost certain to be granted a franchise to cross the tide-flats and enter the latter city. A project of this kind has been on foot for some years, but various reasons have heretofore made it impossible to secure the necessary franchise. The ordinance, which was recently referred to the judiciary committee of the city council, grants a 25-year franchise and confers the right to build single or double track lines upon the streets. Work must begin within six months and the line must be in operation within two years.

THE GENERAL ELECTRIC COMPANY of New York has filed a suit in the United States Circuit Court at Los Angeles, Cal., against the San Joaquin Electric Company, in which it asks to recover certain appliances valued at $90,000, and $10,000, which it claims to have lost through the action of the defendant company in keeping the plaintiff from the use of its property. The General Electric Company alleges in its bill that it is the owner of the plant and sub-plant of the California company, located at Fresno, and that the defendant has refused to surrender the property, holding it contrary to the wishes of the plaintiff since March 11. By being kept out of possession of its alleged property, the company claims that it has been the loser to the extent of $10,000.

CANADIAN NOTES.

NEW LIGHTNING ARRESTER.—Mr. Frank A. Cote, of the firm of Cote & Coursolles, of Ottawa, Ont., has invented a new lightning arrester for telephone, telegraph and general electrical systems. The invention was tested recently in the presence of the experts of the Bell Telephone Company, and it proved highly successful, the strongest currents being intercepted. The contrivance is very simple and one of its features will be the reduced cost of manufacture.

MUNICIPAL LIGHTING IN BARRIE, ONT.—The Town Council of Barrie, Ont., having gone into the municipal electric lighting business, has fixed the price all round the lowest in Ontario. Store lights start at $5 per single light per annum, and grade to $2 per light for twenty and over; residences, $4 for one light, and $1.50 each for twenty or over. Churches are supplied at $1.50 each light per year. Meter rates for ten lights and over have been fixed at 10 cents per kilowatt hour, which is a reduction of 7½ cents on the light companies' rate. The town will spend $10,000 in addition and improvement to the plant.

General News.

THE TELEGRAPH AND TELEPHONE.

SPRINGFIELD, MASS.—The local telephone company will spend $40,000 this spring and summer in conduit construction.

QUINCY, ILL.—The Missouri & Illinois Telephone Company has accepted the franchise ordinance passed by the Quincy (Ill.) Council.

OTTUMWA, IA.—Messrs. Vermilya & Roberts, of Unionville, propose to build a telephone line between Udell, Unionville and Moravia.

FRANKFORT, KY.—A new company has just been organized in Pine Grove, Clark County, under the name of the Old Kentucky Telephone & Telegraph Company.

AURORA, IND.—A contract was entered into by the City & Suburban Telegraph Association, for the equipment of the new exchange here. There was formerly an exchange in Aurora, but it was abandoned and the citizens determined to get up another. Accordingly they secured 50 subscribers and the thing is now a go.

MIDDLETOWN, N. Y.—The Orange County Telephone Company intends extending its line to Port Jervis and Goshen, N. Y. It has now an exchange at Middletown and is operating 365 telephones. T. B. Mills is president of the company; A. B. Wilbur, vice-president; William A. Marshall, secretary; Frank Harding, treasurer, and George A. Otis, general manager.

TRENTON, MO.—The Bell Telephone Company has shipped several carloads of poles, wire and other telephone material to this city, and will begin at once to construct a long-distance line, between Trenton and Kansas City, by the way of Wabash Crossing, Gallatin and Altamont, and will follow the Hannibal & St. Joseph Railroad from Cameron to Kansas City.

LEWISBURG, PA.—The Home Telephone Company, incorporated in 1895, has a capital stock of $10,000. It is operating 250 telephones and has 1000 mileage. It contemplates extension to Williamsport, Bellforn, Daniel, and Bloomsburg, and has exchanges in Lewisburg and Milton. The officers of the company are J. T. Baker, president; C. F. Shaffer, treasurer, and John P. Ruhl, secretary and general manager.

FREDERICK, MD.—The Frederick County Telephone & Telegraph Company has been organized here by James E. Walker, Frank L. Stoner, William P. Maulsby, Dr. P. D. Fahrney, Daniel T. Ordeman, Charles B. Trail, Col. D. C. Winebrenner, John J. Murray and Edwin Devilbiss. The capital stock of the company is $25,000. The new company was formed for the purpose of purchasing the interest of the Interstate Telephone Company in Frederick County. The headquarters will be in this city.

LOUISVILLE.—City Attorney Stone has been asked by Alderman McCall for an opinion as to the legality of the telephone reduction ordinance which has already been passed by the Board of Councilmen, and which will come up in the Board of Aldermen at its next meeting. The city attorney said that he had not yet prepared an opinion. He thought, however, that the legality of such an ordinance would depend upon whether the present rates are reason-

able, and to determine this question they should be compared with the rates in other cities.

PITTSBURG, PA.—Within a few weeks, says the Pittsburg *Dispatch*, all independent telephone exchanges in the cities and boroughs which are not over fifty miles from Pittsburg will be connected and under one management. This is the step towards establishing an independent company which will soon be in operation and have its headquarters in Pittsburg. The company operating the outside exchanges and also organizing new ones is the Home Telephone & Electric Company. All of the instruments of the new company are made in Pittsburg. General Manager T. B. Lee, of the Home Telephone & Electric Company, says the independent exchanges are better equipped than any other now in existence.

ELECTRIC LIGHT AND POWER.

FERGUSON, MO.—The King Electric Light & Power Company will in the near future erect a new brick power house and equip it with new machinery and appliances.

YORK, PA.—It is stated that the Edison Electric Light Company of this city will be sold to outside capitalists. The company will be reorganized on the basis of an increased capitalization.

CAMDEN, N. J.—The Brooklyn Gas & Electric Light Company has been organized in this State with a capital stock of $1,500,000. The incorporators are W. L. Tourney, Maurice Landauer and Frank N. Wirgman.

FULTON, MO.—The city of Fulton, Mo., has voted $4000 for improvements and enlargements in its municipal lighting plant, and has placed the work in the hands of Messrs. Bryan and Humphrey, consulting engineers, St. Louis, Mo.

TAZEWELL, VA.—The town council has granted to Spotts Brothers of this place and John Spotts of Staunton, Va., an electric light franchise. They will endeavor to secure a franchise in the town of Kelly and light both places from the same plant.

WYANDOTTE, MICH.—A special election will be held here on April 17, when a vote will be taken on the proposition to bond the city for $12,000, to be used in the purchase of the Doyle electric plant at $8500, and in making needed repairs at the pumping station.

VINCENNES, IND.—The city of Vincennes, Ind., will on May 22 receive proposals for lighting the city with electricity and with gas. The contract will extend for ten years and carry with it a franchise for private lighting. Messrs. Bryan and Humphrey, St. Louis, Mo., are consulting engineers to the city.

DENVER, COL.—It is thought that the work upon the plant of the Clear Creek Power Company will be commenced during the coming summer. The company proposes to furnish the mines of Clear Creek County with power for hoists, tramways and mining operations of all kinds, as well as lighting the underground works.

CLIFTON FORGE, VA.—The Clifton Forge Light & Water Company has been organized with a capital stock of $100,000. The names of the incorporators are as follows: J. C. Carpenter, P. Seddon Boxley, A. J. Duncan, W. C. Moody, E. A. Snead, D. E. Smith, all of Clifton Forge; S. M. Hamill, Schenectady, N. Y.; George H. Ingalls, Cincinnati, O.

THE ELECTRIC RAILWAY.

MOUNT JEWETT, PA.—A company has been organized here to build and operate an electric railway from this town to Hazelhurst. The capital stock will be $42,000.

DETROIT, MICH.—The Detroit & Lake Orion Electric Railway Company has been incorporated to build and operate an electric railway from Pontiac and Royal Oak via Rochester to Lake Orion.

NEW KENSINGTON, PA.—The Creighton, Tarentum & New Kensington Street Railway Company has asked for a franchise in this borough. This company was recently organized at Harrisburg.

GLOUCESTER, MASS.—Extensive changes are to be made in the power house of the Gloucester Street Railway Company. A new Buckeye cross-compound engine of 600-hp and two new boilers will be installed.

BETHLEHEM, PA.—The Nazareth & Bethlehem Passenger Railway Company has secured the right of way largely through private property. The company intends to build an electric railway direct from Bethlehem to Nazareth.

PITTSBURG, PA.—An electric traction line extending from Pittsburg along the Allegheny River has been projected and will probably be partially built during the next few months. The road will be 28 miles in length. It will be an extension of the street railway of the Tarentum Traction Company.

AKRON, OHIO.—The property of the Akron Street Railway & Illuminating Company was sold at receivers' sale on March 28, to the reorganization committee, for $1,050,000. Bids were made by the Akron, Bedford & Cleveland and Akron & Cuyahoga Falls Rapid Transit Companies.

MUSCATINE, IA.—The property of the Muscatine Electric Light & Power Company, which operates the street railway, electric and gas light plants in this city, was sold recently to Harry W. Huttig, general manager of the Huttig Bros. Manufacturing Company. The plant is valued at $300,000.

ALBANY, N. Y.—The Assembly has passed a bill providing that corporations operating electric and cable cars in any city of over 50,000 inhabitants, shall equip their cars with a guard, fender or sweep which shall be approved by the State Board of Railroad Commissioners.

NEW BRIGHTON, PA.—Two safes in the office of the Beaver Valley Traction Company were blown open and robbed by eight masked men on the morning of March 27. Joseph Billings, the watchman, was rendered senseless by a blow on the head with an iron bar. Another employee was bound to a chair. The burglars secured between $400 and $500, and escaped with their booty.

BUFFALO, N. Y.—It is stated that the George B. Smith electric railway system, embracing the lines in the Tonawandas and the spur on the Buffalo City line to Riverside Park, as well as the Buffalo & Tonawanda road, and all the undeveloped rights of way held by the Tonawanda Street Railway Company will soon be absorbed by the International Traction Company. All the preliminaries have been arranged.

MOUNT PLEASANT, PA.—The Connellsville, Scottsdale & Mount Pleasant Electric Street Railway Company has been organized. It is stated to be the company's intention to cover the entire region round about the towns named by extending its own lines and leasing or buying those now in operation and making connections at West Newton for Pittsburg. Mr. W. W. Staub, of Pittsburg, is the company's chief engineer.

MILWAUKEE, WIS.—Improvements are to be made on the Belle City Electric Railway to the amount of $75,000 within the next two years. The money for the improvements is to be derived by assessment of the stock of the company and by the bondholders turning in the interest on the bonds for two years. The improvements will include new trucks and motors under the old cars, new cars, new overhead equipment and new rails, and the power house will be enlarged.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company has issued a notice that on and after June 1, all conductors and motormen now in the employ of the company will receive 18 cents an hour. For those entering the service after that date, the rate for the first six months will be 16 cents an hour; for the second six months 17 cents an hour, and after the first year 18 cents an hour. The present wages of conductors and motormen on the interurban lines are 17 cents an hour, and on those of all other lines 16 cents an hour. The company now has in its employ about 1000 trainmen and the advance of wages will cost the company about $20,000 a year.

MOUNT VERNON, N. Y.—It is stated that the Tarrytown, White Plains & Mamaroneck Railway has been sold to the Union Railway Company. The price is said to be about $550,000. The company owns twenty miles of franchises in Westchester county. A line is in operation from Tarrytown on the Hudson to Mamaroneck on the Sound, passing through White Plains. A few days ago the town authorities of East Chester and Scarsdale gave a franchise from Mount Vernon to White Plains, enabling the road to make a connection with the Union Railroad in this city. The Union Railroad Company now has all the surface lines in Westchester County except two small local roads, one in Larchmont and the other in Port Chester.

LEGAL NOTES.

EYESIGHT.—No man should be a motorman who has not complete use and sight of both eyes. Rice vs. Crescent City R'y Co.; La. S. C., 24 So. Rep., 791.

EQUAL RIGHTS.—An instruction that an electric street railway has only an equal right with the traveling public to the use of the street whereon its track is built, is erroneous. Clark vs. Bennett, Col. S. C., 55 Pac. R., 908.

RECEIVER FOR THE JOHN T. NOYE MANUFACTURING COMPANY.—Mr. Edwin P. Sears, of Buffalo, was on Feb. 6, appointed permanent receiver of the John T. Noye Manufacturing Company, of Buffalo. The company petitioned for voluntary dissolution, and Receiver Sears is now closing up its affairs.

RULE FOR VEHICLES.—One who drives a vehicle upon an electric railway crossing when the view is obstructed, without slowing up and looking for a car, cannot recover for injuries caused by a car, though it was negligently operated by those in charge. Darwood vs. Union Traction Co., Pa. S. C., 42 Alt., R. 290.

SUIT TO FORFEIT TEXAS ELECTRIC CHARTERS.—A recent despatch from San Antonio, Texas, states that suit has been commenced in the name of the state, to forfeit the charters of all the street railway, electric light and gas companies in the city which were absorbed recently by a syndicate of New York capitalists. The charge is made that the combination is in violation of the Texas anti-trust law.

EMPLOYERS' LIABILITY ACT.—The Indiana Supreme Court reversed the judgment for $8000 obtained by Anna Moore against the Pennsylvania Railway Company for the death of her husband, a telegraph operator, in the employ of the company. An engine without a light was backed against him while delivering orders and killed him. The court held that the acceptance of $500 from the relief department maintained by the company precluded a recovery under the contract of employment which provided that when disability comes, and all the facts and conditions are known, the employee is at perfect liberty to then choose between the relief fund and the treasury of the company—whether he will accept the sure and immediate benefits from the relief fund, or take his chances in the courts against the company; the adoption of one course is the abandonment of the other. Such a contract bears no resemblance to the contract forbidden by the Employees' Liability Act relieving the company from liability for the future negligence of itself and of its employees. In short, if an injured employee or his representatives accepts compensation from the relief fund, they forfeit any right of action against the company. This decision is of vital interest to corporations maintaining a relief department. The Indiana Supreme Court previously held that such a contract was invalid and void, but having given the subject more consideration, overrules its former decision.

CONSTRUING A LIGHTING CONTRACT.—Y. D. Dechert, receiver for Joseph Ryan, brought suit against the Municipal Electric Light Company, of Brooklyn Borough, New York, to recover damages suffered by Ryan because of the destruction of his place of business, for the reason, as claimed, of the negligence of the company in not properly insulating the wires, the consequence

of which was that the electric current set fire to the building and destroyed it. The complaint was dismissed, but this action has been reversed by the Appellate Division. Ryan entered into two contracts with the company, both executed the same day, the first for equipping premises belonging to him with wires and other appliances for the use of electricity, and the second for furnishing electricity. In the second contract there was a provision which released the company from all claims resulting from the use of an electric current when the wiring and electrical equipments on the premises of the consumer had been approved by the New York Board of Fire Underwriters or other proper authorities. Justice Rumsey, giving the opinion of the court, holds it to be quite clear that the terms "electrical equipment" and "wiring" were used as representing two different things, and that the electrical equipment, put in after the wiring was completed, could not be deemed to include the wiring, which was a different thing, done at a different time, and not necessarily connected with the equipment.

PERSONAL NOTES.

MR. SAMUEL INSULL, president of the Chicago Edison Company, was in New York the past week.

MR. C. C. WARREN, of the Warren Electric Manufacturing Company, Sandusky, Ohio, is in Florida.

MR. FREDERIC NICHOLLS, vice-president of the Canadian General Electric Company, of Toronto, was in New York last week, making some important arrangements in connection with automobile work for Canada.

PROF. A. B. W. KENNEDY, F. R. S., who has been retained by the London County Council to advise them on the question of the proposed electrical equipment of the London tramways, is on a short visit to this country investigating certain points in American practice on the ground.

MR. C. L. EDGAR, vice-president of the Boston Edison Company, was in New York City last week carrying through some important deals in connection with automobiles and electric launches, in both of which industries he is actively and personally interested, as a strong believer in their present and future.

MR. J. J. BELLMAN, who has been with the Crocker-Wheeler Electric Company for some time in the capacity of designer of special machinery at its works, has been recently assigned to the company's Chicago office as electrical engineer. Mr. Bellman's familiarity with the electrical equipment of printing presses makes him a particularly valuable man for this position.

OBITUARY NOTES.

MENARD K. BOWEN, president of the Chicago City Railway Company, died on April 9, at the Chicago Hospital, from the effects of an operation for appendicitis performed the day before. He was born at Jefferson Barracks, Mo., in 1858. He was a son of Gen. John S. Bowen. When quite a young man he earned a reputation as a street railway manager in Kansas City. From there he came to New York, and a year later he went to Chicago as superintendent of the City Railway Company. In January, 1897, he was elected general manager, and in January, 1898, was made president of the road, becoming very well known in electrical circles through his progressive work in that capacity.

EUGENE NAPOLEON BECUE, superintendent of the Commercial Cable Company's station at Havre, France, died at that place on March 31 last. Deceased entered the French Administration of Telegraphs in 1862. He was attached to the Cabinet of the Viscount de Vougy, Director General, when in 1869 the Societe du Cable Transatlantique Francais laid the first French transatlantic cable. That company needed telegraphists understanding the English language and offered him a situation at Brest, which he accepted, and he then went to England to become familiar with the apparatus in use on submarine cables. In 1879 he took charge of the Cie Francaise du Telegraphe de Paris a New York cable at Brest, and finally in 1885 he entered the service of the Commercial Cable Company at Havre. He had charge of the latter company's agencies throughout the European continent, besides being its superintendent at Havre. Mr. Becue was thus connected with the submarine cable service for thirty years and was a man of marked ability.

Trade and Industrial Notes.

THE ELECTRIC PROCESS COMPANY has been organized in Newark, N. J., for the purpose of operating cabs in Pennsylvania cities.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., reports a great improvement in its business. It is running its shop to its utmost capacity.

MESSRS. PEPPER & REGISTER, Philadelphia, Pa., on April 6 moved their offices to Rooms 712-715 Fidelity Mutual Life Building, No. 112-116 North Broad Street.

GLASS PIPE.—We have an inquiry for glass pipe for conveying water, carrying wires, etc., and will be glad to receive data or addresses as to makers of such material.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., reports an increase in its business beyond its most sanguine expectations. The company is running its factory night and day.

THE LEWIS MOTOR VEHICLE COMPANY has been incorporated at Trenton, N. J., with a capital stock of $5,000,000. The incorporators are Thomas W. Synnott, Harry A. Berwind and others.

THE PHILADELPHIA RAILWAY TRACK EQUIPMENT COMPANY, with a capital stock of $500,000, has been organized by Conrad F. Clothier, Jr., Thomas A. Burroughs and George H. Johnson, all of Philadelphia.

MR. JAY HOLMES has taken the general agency for the goods of the Onondaga Dynamo Company, Syracuse, N. Y., for New York City and the contiguous territory. His office is at 39 Cortlandt Street, New York.

THE E. W. BLISS COMPANY has issued a very handsomely gotten up pamphlet, giving a few views of the works of the company in Brooklyn. It also shows illustrations of a few of the leading machines manufactured by it.

THE CONSOLIDATED ELECTRIC & MANUFACTURING COMPANY has been organized in Pittsburg with a capital stock of $6000, by John Stadtfeld, Albert Schweitzer, Abe Stadtfeld, Alex. Spire and L. S. Levin, all of Pittsburg.

THE WARD-LEONARD COMPANY, Bronxville, N. Y., recently received an order from the Western Electric Company for forty of its new circuit-breakers. This instrument is illustrated and briefly described on another page of this issue.

MESSRS. FRANK H. STEWART & CO., 35 N. Seventh Street, Philadelphia, Pa., are placing upon the market a new patented lamp adjuster which is meeting with great success. It is said to offer many advantages over the old style adjuster.

THE SHAWMUT FUSE WIRE COMPANY, Boston, Mass., on March 27, suffered the loss by fire of its office and factory at 93 Federal Street. The company has secured permanent quarters at 161 High Street, where it will be pleased to see its customers and friends.

PLUMMER, HAM & RICHARDSON.—Messrs. Edwin W. Ham and Frank A. Richardson have bought the interest of Mr. F. O. Plummer and will continue the business of electrical contracting under the old firm name—Plummer, Ham & Richardson—at Worcester, Mass.

WETHERILL CORLISS ENGINES.—The shop of Robert A. Wetherill & Co., Chester, Pa., manufacturers of Corliss engines, etc., is being run day and night to enable them to complete the large number of contracts that they have on hand for special engines and apparatus.

THE NATIONAL ELECTRIC COMPANY, Detroit, Mich., has been organized to manufacture electrical supplies. Its capital stock is $50,000, and the incorporators are Frank G. Smith, Theodore Luce, Jr., John T. Nichols, A. H. Sibley, Lewis T. Bennett and Harry H. Wright.

THE ELECTRIC DIMMER & APPLIANCE COMPANY has been organized under the New Jersey laws with a capital stock of $100,000, to manufacture electric lamp dimmers. The incorporators are Arch. A. McGlashan, Joseph J. Deane, Joseph Kelly, Robert G. McCormick and Thomas J. Kennedy.

PRESIDENT FELIC HAAC, of the American Silk Manufacturing Company, Philadelphia, is sending out to the electrical trade pamphlets embracing numerous testimonials to the value of his silk commutator wiper. It is said that these silk wipers will outlast cotton wipers in the proportion of about ten to one.

THE TELEPHONE MANUFACTURING COMPANY.—On March 30 fire damaged the finishing department and a portion of the stock rooms of the Telephone Manufacturing Co., Sumter, S. C. Temporary quarters have been erected for the woodworking force and the company is now ready to make shipments as usual.

WEBSTER VACUUM FEED-WATER HEATERS AND PURIFIERS.—The Warren Webster Company, Camden, N. J., during the past three months has sold feed water heater equipments to 21 different plants throughout the country, including one to the Fremont Electric Light Company, Cripple Creek, Col.

THE GARVIN MACHINE COMPANY, Spring and Varick Streets, New York, is sending to the trade a card containing an illustration of the company's No. 3 universal cutter and tool grinder. Attention is called to the fact that this machine is "four machines in one." The Garvin company announces that it has 450 machines ready for delivery.

THE WESTERN ELECTRIC COMPANY, Chicago and New York, has issued Bulletin 19F, which describes the Arctic ceiling fan and accessories. This is the fourth of a series of bulletins describing the various fan motors manufactured by the Western Electric Company. The same company has also issued a catalogue of its "Petite" arc lamps.

THE SUTHERLAND CONSTRUCTION COMPANY has been organized in Jersey City, N. J., for the purpose of building electric light plants, street railways and gas works. The capital stock is $1,000,000, and the incorporators are Ulysses S. Grant of New York; William Mainland of Oshkosh, Wis., and Alexander M. Sutherland of East Orange, N. J.

THE WESTON ELECTRICAL INSTRUMENT COMPANY is making contracts for its new factory at Waverly, N. J., a suburb of Newark. A railway switch is now being constructed to the spot and ground will be broken in a few days for the erection of what will probably be the most complete manufacturing establishment in the United States.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued circular No. 48, which is a reprint of the recent lecture of Mr. Joseph Appleton before the New York Electrical Society on the "Latest Progress in the Application of Storage Batteries." The application of storage batteries to lighting and power stations is clearly discussed.

THE TURNER ENGINEERING COMPANY, Bucyrus, Ohio, is furnishing two 200-hp "Turner" water tube boilers for the Ohio Central Traction Company, three of 225-hp for the Indianapolis Ice & Cold Storage Company, and one of 250-hp for the Findlay (O.) Street Railway. Large boilers of this type recently put into service are reported to be showing excellent results.

THE L. P. & D. TRANSMITTER COMPANY, Montpelier, Vt., reports that it is getting considerable business from isolated plants, as well as from central stations, that want to increase their capacity, but are short of room for additional machinery. Belted apparatus, the company states, can be bought much cheaper than direct-connected, and often gives better results.

THE WESTERN ELECTRIC COMPANY, Chicago, carries in stock alternating current Stanley motors for any voltage and any frequency from one-quarter horse power up to ten horse power, and transformers from 10-light

capacity up to 300-light capacity. Bulletin 18 F has just been issued by the company, which describes alternating current motors for both ceiling and desk use. A copy of this bulletin will be mailed upon request.

THE "SAFETY" SOCKET HOOK (see that "snap!") is an original specialty designed and manufactured by the Electric Appliance Company, of Chicago. The special feature is a spring which holds the socket hook firmly in place on the screw eye, which is used in connection with it; thus preventing the lamp from being broken by being jarred or knocked from its position. The "Safety" socket hook is a marked improvement over the regular style.

MR. GEORGE W. LORD, of Philadelphia, manufacturer of boiler compounds, has recently distributed among boiler users a treatise bearing the title "Essays upon Boiler Encrustations and Corrosions and Boiler Explosions and the History of Natural Water Contaminations." The treatise contains 78 pages. A copy will be mailed free on application by any one interested. Mr. Lord is also distributing a handsome souvenir entitled "Beauties in Art," which are photogravures in high art. This will also be mailed upon application.

THE WILEY ELECTRIC COMPANY has been incorporated in Portland, Me., to carry on the business of manufacturing and selling primary and secondary batteries, electrical machinery, supplies, etc. The company is capitalized at $500,000. The directors are George J. Bicknell, Frank R. Wiley, Frank G. Curtis, Joseph H. Parker, and Llewellyn Carleton. The clerk is Levi Turner, of Portland; the president is George J. Bicknell, and the treasurer is Frank R. Wiley.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, Philadelphia, has just received a large stock of O. K. wire in all sizes. It states that it can fill all orders promptly. Mr. Roberts also states that he has recently sold to the Southwestern Traction Company, of Philadelphia, submarine armored Kerite cables to cross the Schuylkill River, the aggregate area of which is 1,000,000 circular mils. These are said to be the largest cables in use under the Schuylkill River.

BOILER INCRUSTATION AND CORROSION is a subject that interests every manager of a steam plant, and it is one that demands the most thoughtful study. Mr. George W. Lord, 316 DeLancey Street, Philadelphia, Pa., publishes a 77-page pamphlet of "Essays Upon Boiler Incrustation and Corrosion," which gives much valuable information on this important subject. Every steam user, whether he uses Lord's Boiler Compound or not, will find in this pamphlet much interesting matter on the question of waters for boilers.

MR. ELMER P. MORRIS, 15 Cortlandt Street, New York, has received an order for $11,000 worth of electrical machinery to go to Cape Town, South Africa. Mr. Morris recently shipped 500 iron telegraph poles to a Mexican port, the value of this order being $10,500. A large quantity of electric railway apparatus manufactured by the Electric Railway Equipment Company, of Cincinnati, Ohio, and a number of electrical instruments made by the Keystone Electrical Instrument Company, of Philadelphia, were also recently forwarded by Mr. Morris on foreign orders.

THE MONTAUK MULTIPHASE CABLE COMPANY is just in receipt of a large additional order from Melbourne, Australia, for its fire detective cable. A remarkable feature in connection with this cable is that at this long distance from the point of manufacture, subject to rough usage in transportation, it at once proved its superiority in every way for the purposes designed. It was subjected to practical tests, calling out the fire brigade in ample time for the suppression of fire, receiving the indorsement of Chief Stein, and subsequently receiving the approval of the builders and architects of that city

THE AMERICAN ELECTRIC HEATING CORPORATION, Cambridgeport, Mass., has received an order from Belfast, Ireland, for a lot of electric heating apparatus to be used on the steamer "Oceanic," now being fitted out for the White Star Line. Some of the heating equipment is to be installed on other new ships now building at Belfast. The North German Lloyd Steamship Company is also interested in the use of the electric heating goods of the American Corporation, and a consignment for that company is now on the way to Bremen. Shipments are being made to Australia, Argentine Republic and Japan.

THE BICKFORD DRILL & TOOL COMPANY, Cincinnati, O., has incorporated, with a capitalization of $100,000. The officers are H. C. Hoefinghoff, president and general manager; L. G. Keck, secretary and treasurer; H. M. Norris, engineer and works manager. The company has made some heavy purchases of machinery and with the improvements it is making in its plant it will be enabled to take care of its growing business. The Bickford radial drill has long been recognized as one of the most modern tools of its type on the market, and the multiple drills, also built by the company, are in keeping with the high standard of excellence that its product has always enjoyed.

LARGE ORDER FOR TELEPHONE WOODWORK.—The Western Telephone Construction Company of Chicago has just placed an order for twelve carloads of telephone boxes with the American Hardwood Manufacturing Company of Grottoes, Va., for quick delivery, each car containing more than one thousand complete sets of boxes. In addition to this order it has also contracted with the latter firm for a large quantity of special telephone desk cabinets, switchboard cabinets and other woodwork. Mr. W. F. Livers, the secretary and treasurer of the American Hardwood Manufacturing Company, reports the outlook extremely good in this special line of its business, and states that it has found it necessary to very largely increase its force of mechanics to enable it to keep pace with its orders. It has been making telephone woodwork for the past four or five years, supplying the largest manufacturers of telephones in the country with its woodwork, and the above order is a good recommendation that its product is giving satisfaction.

THE SPRAGUE ELECTRIC COMPANY, New York, is greatly pleased with the reception given by the trade to its new product, the Greenfield flexible metallic conduit. It has been somewhat handicapped in the matter of filling orders on account of insufficient machinery in the flexible conduit department, but several new additional machines have now been added and the capacity increased to fifty tons output per day. Flexible metallic conduit is proving a revelation to the contractor and wireman. The fact that one man and a boy can do in one day the amount of work which would require with any other conduit four or five days, appeals in a most convincing way to wiremen. The ease and quickness with which an ordinary installation can be made almost passes belief until one has examined the conduit and noted its many peculiarities. The Sprague Electric Company claims that flexible metallic conduit offers every advantage that can be obtained with the use of rigid iron pipe, besides contributing many features of superiority not possible with any other system.

THE CUTLER-HAMMER MANUFACTURING COMPANY, 70-82 West Jackson Street, Chicago, Ill., has increased its capital stock from $50,000 to $100,000 rendered necessary by the large increase in the company's business The company was originally incorporated with a capital stock of $10,000, but as time subsequently proved that sum to be insufficient for the demands of the business, it was at various times increased to $25,000 and then to $50,000. This last jump to $100,000 makes the fourth increase in six years, thereby establishing a record for success that can rarely be duplicated. At present the Cutler-Hammer Manufacturing Company has an equipment for the production of rheostats which enables it to supply at the earliest possible moment the largest order that may be sent in. The instruments made by the concern are constructed on exclusive patents entirely the property of the company, and as a consequence it sells heavily to motor manufacturers all over the country, the largest electrical institutions in the union being among its patrons. Immediately in control of the company's affairs are: F. R. Bacon, president; F. L. Pierce, vice-president; J. Gilbert Hickcox, secretary and treasurer. Much of the success of this concern is due to the ability of General Manager H. H. Cutler, who designs all the apparatus.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED APRIL 4, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

622,210. APPARATUS FOR ILLUSTRATING THE PHENOMENA OF THUNDER AND LIGHTNING; W. D. Dodd and A. D. Struthers, of Des Moines, Iowa. App. filed June 13, 1898. A compact and conveniently handled apparatus, including a miniature house equipped with lightning rods, and apparatus, including a "Holtz" machine with suitable discharges for demonstrating the philosophy and utility of lightning rods, and illustrating the phenomenon of thunder and lightning and its effects upon persons and things electrically connected with the apparatus, in such a manner that "electricity will be visible to the sense of sight, audible to the sense of hearing, felt by the sense of feeling, and perceptible to the sense of smell."

622,214. TROLLEY WHEEL; S. W. Fletcher, Lowell, Mass. App. filed July 5, 1898. A construction whereby a new tread may be applied to the wheel when the old tread is worn. The side plates forming the groove are bolted together and clamp between them the removable tread.

622,225. WATER GUARD FOR TROLLEY ROPES OR POLES; T. Hawken, Rockland, Me. App. filed Oct. 31, 1898. A bell-shaped block is strung upon the pole or rope at any point; water traversing the pulley or rope will be shed therefrom by the block.

622,230. CONTROLLING SWITCH FOR ELECTRIC MOTORS; Reese Hutchinson, of Mobile, Ala. App. filed Dec. 9, 1898. (See Current News and Notes.)

622,268. TELEPHONE SWITCHBOARD SYSTEM AND ANNUNCIATOR; G. B. Rogers, of Knoxville, Tenn. App. filed April 27, 1898. There is provided an annunciator and a mode of connecting it to the line circuit whereby it is necessary to employ but one current on the switchboard to restore the annunciators and ring a called subscriber, avoiding the objections to a constant current from the generator on the spring-jack system.

622,328. MAGNETO EAR PHONE; F. H. Collins, Everett, Mass. App. filed Feb. 21, 1898. A person afflicted with impaired hearing is to be equipped with a small telephone receiver adapted to be inserted into the passage of the ear and connected by wires with a small transmitter worn upon the breast, and with a battery and induction coil carried in the pocket.

622,351. STREET CAR SPEED INDICATOR; R. E. Hansburg, New York, N. Y. App. filed March 21, 1895. A small dynamo is geared to the axle and operates an electric bell when the speed reaches the maximum limit, a properly proportioned rheostat being used to predetermine the speed at which the bell shall ring.

622,355. ELECTRIC ELEVATOR; T. W. Heermans and N. Whichello, Chicago, Ill. App. filed Jan. 29, 1898. The arm of the motor rheostat is moved by mechanical means, consisting of a series of eccentric or crank arms of varying positions of eccentricity, arranged to engage the rheostat arm successively through its entire forward stroke.

622,368. ELECTRICAL AUDIPHONE; Reese Hutchinson, of Mobile, Ala. App. filed Feb. 3, 1898. (See Current News and Notes.)

622,369. CONTROLLING SWITCH FOR ELECTRIC MOTORS; Reese Hutchinson, of Mobile, Ala. App. filed Dec. 9, 1898. (See Current News and Notes.)

622,392. METHOD FOR OPERATING ELECTRIC MOTORS; Charles John Reed, of Philadelphia, Pa. App. filed Aug. 17, 1898. Relates to the operation of electric motors from a divided source of electrical energy, such as storage batteries, whereby a constant e. m. f. may be applied to the field, and a variable e. m. f. to the armature. By means of a controller the groupings of the divisions of the divided source are varied in such a manner that the energy used may be supplied approximately equally by the several divisions.

622,398. ELECTRIC STEERING APPARATUS FOR VESSELS; G. Sautter, Paris, France. App. filed Nov. 11, 1898. An electric motor is geared directly to the rudder, and it is stated that a leading feature of the invention is that the number of rotations which the rudder motor will make in either direction, is limited because of this direct connection, the rudder being able to turn only to a given maximum angle; hence each position of the rudder must correspond with the positions of the controlling apparatus.

622,412. TELEPHONE CABINET AND SUPPORT; P. W. Bossart, Marietta, Pa. App. filed Feb. 11, 1898. The portion of the cabinet to which the apparatus is directly secured, is removable from the main portion of the cabinet.

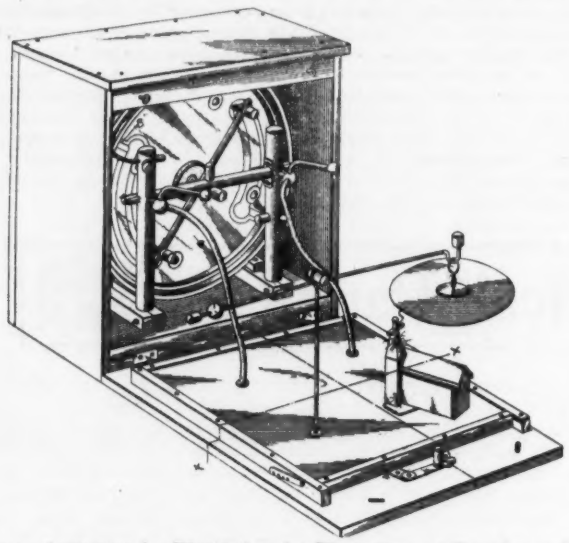
622,413. GRANULAR ELECTRODE AND PROCESS OF TREATING SAME; Paul W. Bossart, of Marietta, Pa. App. filed June 6, 1898. (See Current News and Notes.)

622,430. ELECTRIC ELEVATOR; T. W. Heermans and N. Wichello, Chicago, Ill. App. filed Jan. 29, 1898. A "motor magnet" is used for controlling the circuits of the motor, and means are employed for controlling the movement of the motor magnet; an automatic stop mechanism operates in connection with means whereby the stop mechanism when in operation locks the motor magnet against movement in a reversed direction from that in which it was last moved, but permits its free movement in a direction to reverse the main motor.

622,466. ELECTRIC RAILWAY OR TRAMWAY; Jean Jacques Heilmann, of Paris, France. App. filed Nov. 9, 1898. (See Current News and Notes.)

622,452. MAGNETO ELECTRIC MOTOR DYNAMO; F. H. Donaldson, Garranza, Cal. App. filed April 16, 1898. The field magnet is composed of a series of permanent horse-shoe magnets supported at equal distances apart, while the armature comprises a shaft and a series of electromagnets extending at right angles therefrom and arranged to rotate between the poles of the permanent magnets.

622,531. CONDUIT THREADER; F. A. Pooler, Los Angeles, Cal. App. filed Aug. 15, 1898. In its general features this invention embodies a form of creeper or threader rod, having gripper devices for preventing back movement, a crawler block movable on the rod, and having gripper devices for preventing back movement, and a pair of operating cords or ropes adapted, when alternately drawn backward, to first cause the crawler block to travel toward the head of the threader rod and then pull the said crawler block into a gripped engagement with the conduit wall and at the same time shoot



No. 622,210.—Apparatus for Illustrating the Phenomena of Thunder and Lightning.

the threader rod forward, such movement being continued step by step until the head of the rod projects beyond the forward end of the conduit section with which access may be had.

622,545. MECHANICAL TOY; H. A. Schoknecht and J. C. Elgin, of St. Louis, Mo. App. filed Dec. 27, 1898. Magnets are revolved by means of clock work, underneath a pan of water, to attract bodies floating in the water and move them in unison.

622,596. APPARATUS FOR HOLDING AND CONNECTING GUARD WIRES OF ELECTRIC CABLES. F. A. Cheethan and R. Bostock, of Brigghouse, Eng. App. filed Nov. 22, 1898. The wires are strung in sections, the ends of which are held by hooks, to which pivoted weights are connected. If the wire breaks the weights cause the terminal hooks to drop the broken section bodily.

622,606. CONTACT FOR CONTROLLERS; George Herbert Condict, of New York. App. filed Feb. 7, 1899. (See Current News and Notes.)

622,607. ELECTRICAL ADVERTISING MACHINE; H. W. Cox, Nottingham, Eng. App. filed July 15, 1898. A rotating drum having raised contacts on its surface engages with a set of brushes forming the terminals of lamps located in the face of a sign.

622,608. ELECTRICAL ADVERTISING MACHINE; H. W. Cox, Nottingham, Eng. App. filed Sept. 15, 1898. A modification of the preceding patent, involving a plurality of drums and certain details of construction.

622,609. CARBON BRUSH HOLDER; R. E. Crockett, Michigan City, Ind.

No. 622,328.—Magneto Ear Phone.

App. filed Nov. 29, 1898. The brush is put into a casing and the casing mounted to slide in the holder, devices being provided for facilitating the removal and adjustment of the brush.

622,618. SYSTEM FOR OVERHEAD ELECTRIC WIRES; N. Glasgow, Chicago, Ill. App. filed Jan. 30, 1896. The wire is strung in sections and devices are employed at each junction for grounding the entire section or division, or operate a secondary switch that will, in turn, cut the section or division out of circuit.

622,627. RESISTANCE AND CONTACT APPARATUS FOR ELECTRIC CURRENTS; H. Lyon, of Glasgow, Scotland. App. filed July 6, 1898. This device includes as essential elements, two liquid containing jars, in the bottom of each of which is a metal cup having electrical connections; metal cones having flexible conductors attached thereto are raised and lowered through the liquid by an arrangement of cords and pulleys.

622,628. RESISTANCE AND CONTACT APPARATUS FOR ELECTRIC CURRENTS. H. Lyon, of Glasgow, Scotland. App. filed July 6, 1898. A modification of the preceding patent.

622,629. MULTIPLE TELEGRAPH; Ernst Julas Pierre Mercadier and Henri Robert Joseph Pierquin, of Paris, France. App. filed Jan. 3, 1896. (See Current News and Notes.)

622,636. SYSTEM OF MULTIPLEX TELEGRAPHY; Henry A. Rowland, of Baltimore, Md. App. filed April 27, 1896. (See Current News and Notes.)

622,639. ELECTRIC METER; Gustave A. Scheeffer, of Peoria, Ill. App. filed Jan. 20, 1899. (See Current News and Notes.)

622,645. ELECTRO-HARMONIC SIGNALING APPARATUS FOR TELEPHONE SYSTEMS; F. H. Brown, Chicago, Ill. App. filed May 3, 1897. Details constituting improvements upon patent No. 622,646, and consisting essentially of means whereby the signal is produced by the harmonic vibrations of the diaphragm of the receiver.

622,646. ELECTRIC SIGNALING APPARATUS FOR TELEPHONE SYSTEMS; F. H. Brown, Chicago, Ill. App. filed May 3, 1897. The object of this invention, as well as that of the preceding patent, is to dispense

No. 622,531.—Conduit Threader.

with the usual magneto call; by using a rheotome for interrupting the current, and sending the current through the signal bell only (shunting the other instruments), the main battery is utilized for calling purposes.

622,481. MEANS FOR SECURING ELECTRICAL UNITY OF SYSTEMS OF METALLIC PIPES OR MAINS; Dugald C. Jackson, of Madison, Wis. App. filed Oct. 12, 1898. (See Current News and Notes.)

622,511. ELECTRIC SAFETY FUSE OR CUTOUT; W. M. Mordey, Loughborough, England. App. filed Feb. 15, 1897. (See Current News and Notes.)

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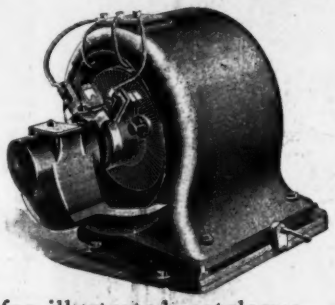

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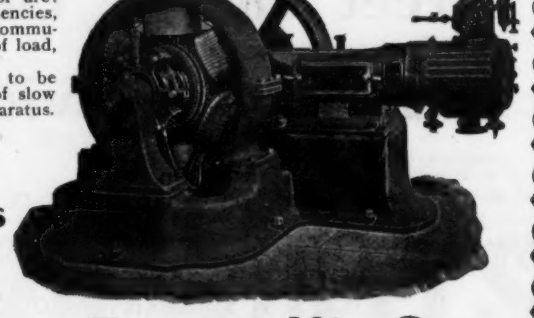

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J. E. Duval, Charlotte, N. C.; J. Oliver, Memphis, Tenn.; W. H. Jenks, Richmond, Va.; J. S. Crump, Columbus, Ind.; C. K. Hill, Pittsburg, Pa.; Robert R. Jones, Harrisburg, Pa.; F. E. Getts, 63 So. Canal St., Chicago; Hay & Hotchkiss Co., New Haven, Conn.; C. H. Maxfield, Belfast, Me.; Morris Putzel, Macon, Ga.; Western Electric Works, Los Angeles, Cal; J. M Lansden & Co., Birmingham, Ala.; W. C. Reed, Lockport, N. Y. [3]

1899. CATALOGUE 1899.

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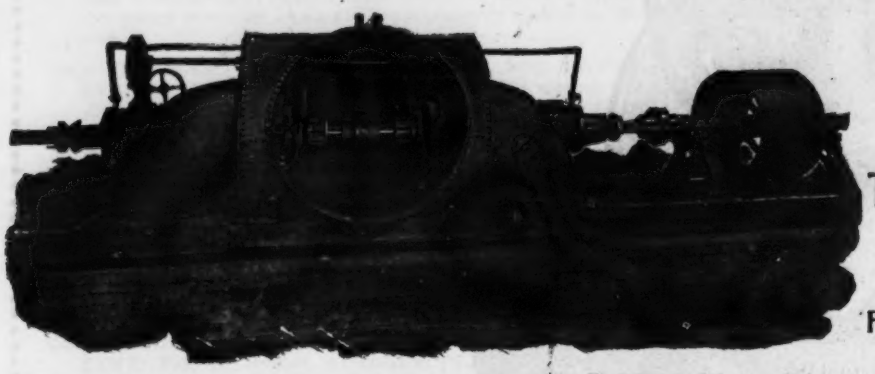

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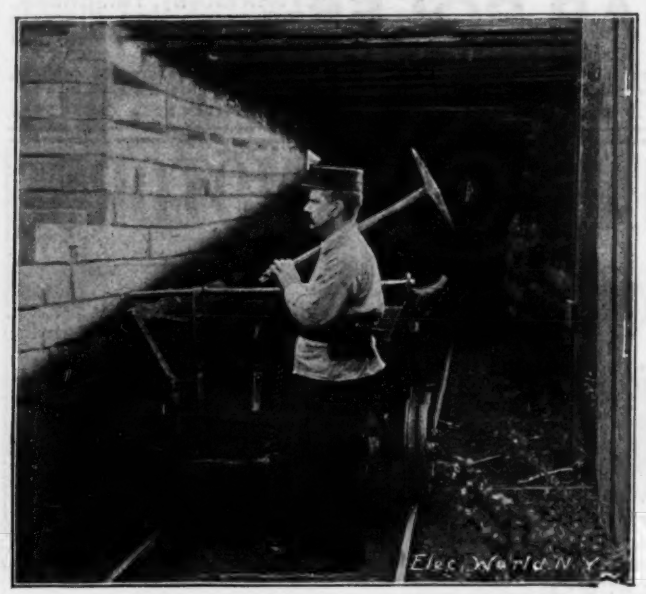

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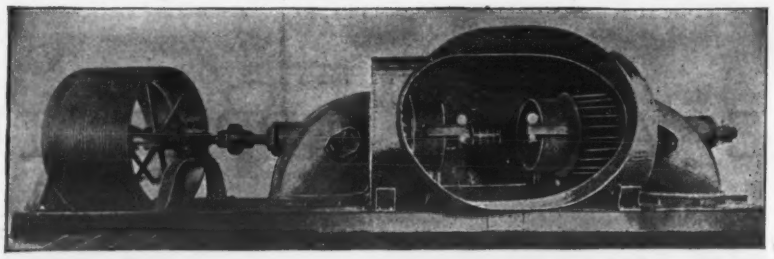

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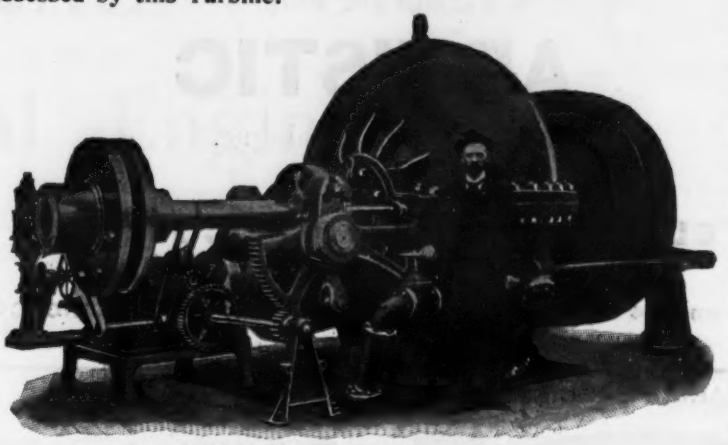

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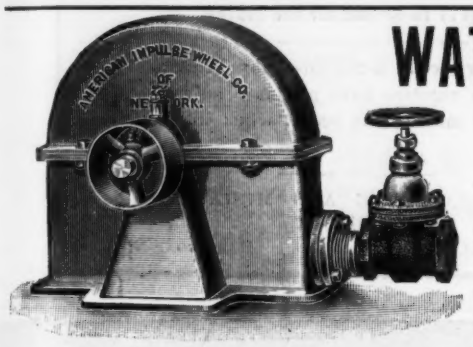

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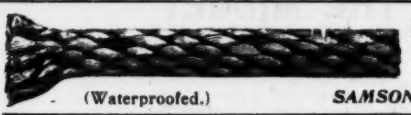

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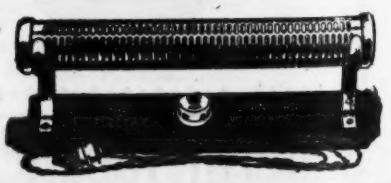

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